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Cover:

A Canadian 1-dollar silver coin made at the royal Canadian Mint in Ontario, showing the modern skyline of Toronto, capital of Ontario and an Indian paddling a birch bark canoe across Toronto Bay. It commemorates the establishment of Toronto, Ontario as a city in 1834. The settlement of Americans loyal to the Crown in what is now the Province of Ontario dates from 1784.

NOTE:

This background discussion paper does not represent official policy and the views expressed herein are not necessarily the viewpoint of the Government of Ontario.

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SILVER

THOMAS PATRICK MOHIDE

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Dedicated to

Jean Dorothy Mohide
Deirdre Siobhan Mohide
Patrick, Ann and Christie Mohide

and to the memory of my great-grandfather

Thomas Lloyd, silversmith

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INFORMATION AND DATA ON SILVER CONSUMPTION AND SOME MINE AND REFINERY PRODUCTION DETAILS ARE SOMEWHAT DIFFICULT TO OBTAIN.

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Metals Week, New York
Mineral Policy Sector, Department of Energy, Mines and Resources of the Government of Canada, Ottawa, Ontario
Department of External Affairs of the Government of Canada, Ottawa, Ontario
Department of Finance of the Government of Canada, Ottawa, Ontario
Royal Canadian Mint, Ottawa, Ontario
Royal Mint, London, U.K.
Bureau of the Mint, U.S. Government
Bureau of Mines, U.S. Government
Government of the Republic of South Africa
Government of Australia
Government of Peru
Government of Mexico
Government of Chile
Government of Japan
Kidd Creek Mines, Timmins, Ontario, Canada
Inco Ltd., Toronto, Ontario
Noranda Mines, Toronto, Ontario
Agnico-Eagle Mines, Toronto, Ontario
Johnson Matthey, Toronto and Brampton, Ontario
Johnson Matthey, U.K.
Johnson Matthey, U.S.A.
Imperial Smelting and Refining, Markham, Ontario
Degussa, Ontario, Canada
Degussa, U.S.A.
Engelhard Industries, Aurora, Ontario
Engelhard Industries, New Jersey
Engelhard Industries, U.K.
Anglo-American Corporation of South Africa
Charter Consolidated, U.K.
Consolidated Gold Fields Ltd., U.K.
General Mining Union Corporation Group, South Africa
J. Aron/Goldman Sachs, New York

Philipp Bros., New York
Salomon Bros., New York
N.M. Rothschild and Sons, London
Mocatta Metals Corporation, New York
Sharps, Pixley, New York
Handy and Harman, New York
Bank of Nova Scotia, Toronto, Ontario
N. "Nick" Carsillo
D.L. Alexandre
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Foreword

This report, "Silver", is the 20th basic reference publication in a series of studies prepared by staff members of the Mineral Resources Branch, Mineral Resources Group, Ministry of Natural Resources of the Government of Ontario. The series has grown out of the recognition that each of the major metal commodities produced in Ontario is a unique entity with special characteristics, operating in a worldwide market.

Silver is among the most important metals mined in Ontario and Canada in terms of aggregate value and the provision of jobs. About three-quarters of the world's newly mined silver comes from North and South America.

Silver is one of the world's most precious metals, valued for its unique properties, its brilliance, scarcity, its resistance to corrosion and its electrical, bactericidal and lubricating properties.

Silver has no competitors in 90 per cent of its uses and its price is relatively low.

Silver has a more universal appeal than the more expensive precious metals.

There has long been a need for a truly comprehensive treatise on silver. This desk-top reference is an effort to fill that gap and to provide interesting reading in the process.

This book is therefore not directed at a highly technical audience, but rather it is aimed at providing an easy-to-read comprehensive picture for those people who from time to time would like to know more abut this very important and glamorous precious metal, in a handy form, including those who are still at school.

Canada is the world's fourth largest source of silver and Ontario normally mines far more silver than any other Province. Silver is an important byproduct of the Kidd Creek base metal mine at Timmins, Ontario, Noranda's Ontario operations at Mattabi Mines and its Geco Division, the Sudbury, Ontario operations of Inco and Falconbridge and at the Agnico operations at Cobalt, Ontario. The silver by-product of the mining of base metals keeps many such copper or lead-zinc mines open and their associated jobs.

Silver has, throughout the ages, always been regarded as a safe haven for wealth, (even modest wealth), because of its high intrinsic value.

SILVER NEEDS NO-ONE'S SIGNATURE TO MAKE IT VALUABLE.

Silver and gold are the world's two oldest traded investment commodities.

Traditionally, silver has been associated with the good things of life — splendour, high adventure, celebrations, some religions, great art, beauty, joy, the desire for wealth, prosperity, peace — all that is good and beautiful. It is also vital in many treatments of the human body, from babies to adults. That is the context in which silver belongs and where its value can best be understood and appreciated.

Silver is increasingly desired for its happy marriage of beauty, pleasure and function and for its intrinsic and enduring value.

> "Come live with me and be my love,
> And we will some new pleasures prove,
> Of golden sands and crystal brooks,
> With silken lines and silver hooks."
> —John Dionne, 1571-1631

The living beauty of the metal is shown in the timeless fascination of the lustrous white sheen.

The allure of silver is undeniable. Many people prefer silver in, for example, jewellery, because it

1) is rare, being relatively scarce, yet not cripplingly expensive and has always bestowed a certain cachet on its owner.

2) has long been desired and treasured as a personal adornment for its Beauty — silver, with its beautiful white colour, has a reflecting lustre unattainable in other material. Stainless steels, for example, are often a long way from being "white" and never have the brilliance of silver.

3) is obtained and worked into jewellery and artifacts with comparative ease. Silver is pleasing to the touch and delightful to the eye.

4) has Permanence — its resistance to decay and its durability must have given silver a supernatural quality from the earliest times. It neither corrodes nor tarnishes in normal air, (except where sulphur products are in the air, as in parts of our modern society). Until about the 16th Century, the air in Europe, for example, was pure and did not affect silver. Silver can be buried in the earth or in the sea for long periods without deterioration.

5) has Convertibility and Divisibility. It has been and still is a time-honoured medium of exchange. If hard times come, the owner of silver can always melt it down to purchase food and/or freedom and this still happens quite frequently in the Far East and India during famines, floods etc.

6) has Consistent Quality.

7) has Great Durabillity.

8) has Great Versatility.

9) silver is convenient.

Thus a demand built up for silver for ornamentation and personal adornment as well as a "store of wealth". Millions of people still invest in silver in bullion or coin form, all over the world.

Silver retains the special advantage of being the least expensive of the precious metals.

THE BOOK PROVIDES, WITHOUT BEING TOO TECHNICAL, A COMPREHENSIVE REVIEW OF SILVER WITH A LOOK AT INTERESTING INDIVIDUAL USES, MEDICAL USES, DISCOVERIES OF TREASURE HOARDS OF SILVER, SILVER COINS, MINE OUTPUT ETC. THIS MEANS THAT THE INFORMATION ON THE METAL IS SELF-CONTAINED, ELIMINATING THE LOSS OF TIME INVOLVED IN REFERENCE HUNTING.

A systematic and detailed account of the fascinating history, the aesthetics, the sources, the economics and the market for silver is also provided.

The chapters covering silver's physical, chemical and mechanical characteristics give many examples of the modern exploitation of silver's unique properties in a wide variety of applications in photography and X-ray films, electronics, electrical contacts, holloware, flatware, electroplating, the Space Shuttle, mirrors, medicine and dentistry, batteries, the Viking Spaceship, conductive coatings, jewellery, coins, brazing alloys, bearings, and powders.

A NUMBER OF CHARTS, TABLES AND FIGURES ENHANCE THE BOOK'S USEFULNESS TO THE READER AND HOPEFULLY CONTRIBUTE TO ONE'S FURTHER ENJOYMENT.

THIS STUDY CLOSES WITH AN EXECUTIVE SUMMARY AND RECOMMENDATIONS WHICH HOPEFULLY WILL HELP TO STIMULATE AND ACCELERATE BOTH ONGOING OUTPUT AND THE FUTURE SEARCH FOR NEW DEPOSITS, PARTICULARLY IN ONTARIO, THE SOURCE OF SO MUCH SILVER TO DATE.

Chapter 1

The 8 Precious Metals — Also Called the Noble Metals

"METAUX PRECIEUX" IN FRENCH;
"EDELMETALLE" IN GERMAN;
"METALLI PREZIOSI" IN ITALIAN.

Precious (or noble) metals are so called because they withstand severe heat and corrosive environments, resisting oxidation in air or water and resisting acid solutions, i.e. a reluctance to dissolve in media that will corrode almost any base metal. (Nobility can be defined as an ability to remain unchanged in various environments.)

THREE OF THE SIX PLATINUM GROUP METALS ARE USUALLY MUCH MORE EXPENSIVE THAN GOLD – IRIDIUM AND RHODIUM, (OFTEN TWICE AS EXPENSIVE), AND PLATINUM ITSELF.

SILVER IS THE LEAST EXPENSIVE OF THE PRECIOUS METALS.

It is very unlikely that new substitutes will be found for many of the extremely wide-ranging applications which utilize the precious metals, including silver.

THE 8 PRECIOUS METALS COMPRISE:

a) The two Ancient Precious Metals

Silver
Gold

b) The six modern Platinum Group Metals, (P.G.M.'s or the Platinoids), discovered in the last few centuries.

Platinum
Iridium
Osmium

Palladium
Rhodium
Ruthenium

1.1 PART OF THE PERIODIC TABLE OF ELEMENTS

Fe	Co	Ni	Cu	
26	27	28	29	
Ru	Rh	Pd	Ag	)
44	45	46	47	) The 8
				) Precious
Os	Ir	Pt	Au	) Metals
76	77	78	79	)

The figures are their atomic numbers.

Chemical Symbols

Ag	Silver	Co	Cobalt
Au	Gold	Cu	Copper
Ir	Iridium	Fe	Iron
Os	Osmium	Ni	Nickel
Pd	Palladium		
Pt	Platinum		
Rh	Rhodium		
Ru	Ruthenium		

Chapter 2 Silver

Silver is fascinating. It is one of the most romantic of all metals. It receives affection and attention to a degree that borders on worship. Great is the mystique of silver. A yearning for silver appears to be ingrained in the human psyche. There has been a timeless fascination with its lustrous white sheen.

It is a word built into the very language of our Judaeo-Christian culture and that of Islam, the Middle East, India and East Asia.

Silver has a very long history, which is a rich one in all senses of the word and stirs many people.

Silver has enthralled man since the dawn of civilization. Silver was almost certainly one of the first metals to attract the attention of man, because of the dazzle and allure of its brilliant reflective appearance, its unalterability by oxygen corrosion — freedom from corruption — and its occurrence in the native condition in the ground. The first two metals that man was able to melt and work were copper and gold, as far as present knowledge takes us, closely followed in time by silver.

Throughout history, silver has been a lodestone drawing men into remote spots in the hope of wealth.

Silver and gold are the world's two oldest traded investment commodities.

The Northern Europeans, the Irish, the Celtic Britons, the Spaniards, the Scythians, the Mesopotamians, the Persians, the Afghans, the Greeks, the Carthaginians and the Romans each in turn exploited the silver ore reserves of Europe, the Mediterranean and the Middle East long before Christ, in their desire for the lustrous precious metal which made their rulers beautiful, wealth and powerful. Some of their amazingly sophisticated silver pieces can still be seen on display in the great museums.

Silver first began to be extracted from ores about 6,000 years ago and worked by man in any quantity from about 5,000 years ago.

Mankind has had a very special relationship with silver for thousands of years. It will probably continue and more and more people want to own some of it.

There is a very close connection between much gold and silver and great economic expansion as can be seen in the rise of early Rome with Spain's silver, the sudden rise of medieval Spain with the flow and gold and silver from the Americas, the vigour of Elizabethan England and the great expansion in world-wide trade and commerce which followed the opening of the large silver mines in Nevada and the gold mines of California, Australia, Canada, Russia and South Africa in the nineteenth century.

Silver is not a scarce strategic metal, but it does have unique and vital uses in industrial and military equipment. However, in a really desperate supply situation, there would always be enough on-surface products such as jewellery and tableware that could be obtained at a price and melted down for emergency use in most industrialized countries.

It is, however, a vital monetary metal and is likely to remain so, as it has for at least six thousand years.

2.1 SILVER'S AGE OLD ALLURE

The age-old allure, the gleaming quality of silver, as well as its malleability, have attracted men and women from the earliest times, all over the world.

Silver is unique among the precious metals for its combination of living beauty, value, wide utility and relatively low price.

ANCIENT SOURCES

"Those who do not learn from history are condemned to repeat it."

Silver is the most plentiful of the precious metals.

With gold and copper, silver was one of the first three metals that were discovered and worked by man. Although known and valued by man from the prehistoric era, silver may have been discovered a little later than gold, but nevertheless it was used in extremely early times before 4,000

B.C. Silver has been obtained from the earth and been greatly valued and used for jewellery, ornaments, money, etc. ever since that time.

Silver has in history been very much a woman's metal, although certainly not exclusively.

How did the ancient peoples wear silver and gold? One portrayal survives from Ireland, describing a girl from some two thousand years ago, named Etain, granddaughter of Etain and Midir of Bri Leith.

> He, the king, saw a woman at the edge of a well and she had a silver comb with gold ornament. She was washing in a silver basin on which were worked four birds of gold and bright little gems of purple carbuncle on the chasing of the basin. She wore a purple cloak of good fleece, held with silver brooches chased with gold and a smock of green silk with gold embroidery. There were wonderful ornaments of animal design in gold and silver on her breast and shoulders. The sun shone upon her so that the men saw the gold gleaming in the sunshine against the green silk. She was undoing her hair to wash it.

Many modern women would not be averse to an outfit like that.

The smelting of silver and gold from ores, (as distinct from finding silver in its native metallic state), was known as early as 4,000 B.C. In a charcoal fire, silver chloride ore is easily converted to silver metal bullion.

Silver was not mined in ancient Egypt but was known about 4,000 B.C., and it was very scarce. They called it "white gold" and it almost certainly came from Asia Minor, even at the earliest period.

The Age of Metals itself began not later than 4,000 B.C.

All the ancient units of value were weights, (of silver and gold).

The predecessors of the Hittites in Asia Minor produced silver in volume in the millenium, 4,000-3,000 B.C.

One ounce of gold was worth 2.5 to 3 ounces of silver around 3,500 B.C. in Egypt. By about 2,700 B.C. the exchange rate was 1 ounce of gold for 9 ounces of silver.

We have silver ornaments from the very ancient Chaldaean royal tombs in southern Iraq and silver even appears to be mentioned as money in a Sumerian script of that area of some 5,500 years ago.

By 3,100 B.C., silver, gold and copper were in use in Crete, a large island of Southern Europe. Ambassadors to the Egyptian king from Kefti or Keftiu, their name for Crete, brought silver vases as gifts.

One of the most ancient silver objects surviving today is a silver vase from Chaldea which is in the Louvre, Paris, dated at about 2,850 B.C.

BEFORE 4,000 B.C.

INVENTION OF METALLURGY

Before prehistoric man could work silver, the art of melting (smelting) and metallurgy had to be invented.

Many archaeological scholars are now convinced that the prehistoric inhabitants of the Balkans region in Eastern Europe invented metallurgy before 4,000 B.C., well before and independent of the peoples of the Middle East. Tree ring and radiocarbon dating confirm this. The discovery of two prehistoric copper mines at Ai Bunar in Bulgaria and Rudna Glava and Rudnik in what is now Yugoslavia — both up to 6,000 years old, support this also.

BRONZE AGE

In the Old World of the Eastern Hemisphere, the first period of metal use was based on copper and its alloys. Beginning in Europe and the Middle East and independently in Southeastern Asia at the same time, this alloy technology spread among both peasant and urban societies. Bronze Age civilizations included Greece, Ireland, Britain, Spain, France, Sumer, Egypt, the Indus and Shang China.

Iron began increasingly to replace bronze after 1,000 B.C. and both can still be considered as some of the world's most important materials.

EGYPT

In the earliest records of Egypt, silver was much more valuable than gold.

The punishment for at least one trusted manager in ancient Egypt, Akotep, who stole from his master's wealth, was to be covered by one thousand pieces of the rare silver, added one at a time, which of course pressed the life out of him by peine forte et dure, in the words of the similar old English law, not abolished until the middle of the eighteenth century.

In Egypt, as early as about 4,000 B.C., gold was mined from shallow deposits by slaves, to be used in adornment of the kings and the wealthy.

Gold collars were awarded to successful generals by the Pharaoh. The Egyptian hieroglyph for gold, pronounced approximately "K-T-M" or Ketem, was a collar of beads.

Narmer, the first king or Pharaoh of a united Egypt, about six thousand years ago, minted standard size, (14 gram), gold bars stamped with his seal, which may have been used as money. Narmer fixed a value ratio of 2.5 or 3 silver to 1 gold. Gold rings, made to standard weights, were circulated in Egypt to facilitate trade as early as 2,000 B.C.

The ancient name for silver was "K-S-F" or "Kesef", which is much the same as the word used in Canaanite and Hebrew for silver.

Under Menes, in Egypt, 5,200 years ago, gold was still two and a half times as valuable as silver.

The separation of gold from silver (found together in nature as electrum) was probably not practised until around 2,000 B.C. The method of separating and extracting pure gold from the silver and other metals mixed with it was known at an early period in human history, perhaps even as early as before the second millennium B.C.

The Europeans, the Egyptians, the Mesopotamians, the Irish, the Spanish, the Portuguese, the Hittites in what is now Turkey, the Scythians, the Thracians, the Persians, the Ibero-Celts, the Greeks, the Carthaginians and the Romans each in turn exploited the silver ores of Europe, the Mediterranean, Egypt and the Middle East, as well as Indians in the Americas, in their desire for the lustrous metal which made their rulers beautiful, wealth and powerful.

The ancient civilizations of Bulgaria, Egypt, China, Ur, Babylon, Assyria, Minos, Greece, Ireland, Etruria and Peru valued silver highly and some of their beautiful silver pieces can still be seen on display in the great museums.

Silver is referred to in a majority of the ancient Hebrew, Hindu and Chinese manuscripts and on a number of the thousands of inscribed baked clay tablets surviving in the Middle East. Uses of silver mentioned in them were ornamentation of weapons, warhorse bridles, cups, idols, money and jewellery of all types.

4,000 YEARS AGO

IRELAND

Irish prehistoric remains are particularly rich in gold and silver. To look in a museum showcase and find yourself staring at an Irish solid gold or silver collar, exquisitely worked, and to realize that it was made for the lucky wearer about 3,800 years ago, is a very humbling experience. How many of us today could prospect in the bush, obtain the gold or silver, refine it and design and work it to make such a beautiful collar, without our modern aids.

The problems faced by the proto-Celtic peoples and the Celts in Central, Western and Northern Europe in those distant times were formidable:

1) The location, identification and mining of the silver-bearing, gold-bearing and other metal-bearing minerals.
2) The processing by smelting and associated techniques to convert to pure metal — gold, silver etc.
3) The casting, in sophisticated clay moulds, and the finishing of the object.

During the early Bronze Age, over 4,000 years ago, Ireland became a major source of gold and silver. Alluvial deposits in Southern Ireland were worked and ancient Irish records contain numerous references to gold and silver. One major source was the alluvial or placer gold from the beautiful Avoca valley in County Wicklow. Being soft, it could be beaten into thin sheets. The goldsmiths of ancient Ireland obtained much of their gold from Croghan Kinsella there.

In the counties of Tipperary and Limerick in Ireland, gold vessels and ornaments have been found, as well as ladles, crucibles, etc. for working the gold — all from a period of 2,000 to 3,000 years ago. The skill and fame of the Irish goldsmiths was widely known. The people of Leinster province used to be called Laighnigh an Oir, (Lagenians of the Gold) since gold was first found there. The word for goldmine in Irish is oirmhianach, (pronounced ORVANA), and silver is airgead (ARGAD), which were used at least 2,000 years before the English language came into existence in about 1350 A.D. From 'mhian', by itself, we get our English words "mine" and "mining" — from the old Celtic language.

By 1500 B.C., the skills of metallurgy were firmly established in Ireland — producing copper weapons, gold and silver ornaments etc. both for home and for export.

Ireland's collection of native prehistoric gold ornaments is unequalled in Western Europe. Some Irish gold jewellery pieces from almost 4,000 years ago and later and silver of later dates have survived and may be seen in the National Museum of Ireland, the Royal Irish Academy and Trinity College, Dublin.

Gaelic-speaking Celts conquered Ireland by about 400 B.C. or earlier and they were great lovers of gold.

Examples of Celtic gold work which you can see in European museums include:

A gold inlaid hilt on an iron sword — 7th Century B.C.
Gold cup — late 6th Century B.C.
Gold Ornaments — early 4th Century B.C.
Diadem of heavy gold, (from the head of a princess) — ca. 500 B.C.

Ireland's gold brought new settlers and trade with Britain and continental Europe. Neck and hair ornaments of sheet gold were exported to Europe.

Irish gold and silver objects have been found in many countries in Europe and the Middle East.

Evidence exists that gold rings, made to standard weights and circulated to facilitate trade, found use in Ireland 3,600 years ago.

By 700 B.C., there was a very large amount of gold metal in circulation in Ireland.

The bodies of Celtic leaders were buried with jewellery, rings, bracelets and torcs (neck-rings or collars) of gold, *silver* or electrum, a natural *silver*-gold alloy. The neck-ring was the most distinctively Celtic gold ornament. Their horses had gold ornaments also.

The earliest coins that have been found in Britain are not Roman, but pre-Roman Celtic (Gallo-Belgic) gold and *silver* issues of designs that had come over with the Celtic immigrants from the Continent a very long time before the Romans.

Julius Caesar, the Roman who led brief expeditions into SE Britain in 55 and 54 B.C. reported that gold and *silver* were in use by the Celts, the people who then lived there.

The Irish skills in silver and gold culminated in the exquisite complexity of both the Tara brooch (around 700 A.D.) and the Ardagh *silver*/gold chalice (ca. 750 A.D.).

By 1436 A.D., it was still being recorded: "Of *sylvere* and gold there is the oore (ore) amonge the wylde Yrishe" and, of course, nowadays, Ireland is still a notable mine source of silver.

MESOPOTAMIA

This name means "between the rivers", (Tigris and Euphrates, which both flow into the Persian Gulf, or Arabian Gulf).

The people of the land between the rivers Euphrates and Tigris, now comprising most of Iraq, not only invented the wheel but over 4,000 years ago had learned to blend or alloy metals and to produce superb sheetgold jewellery and ceremonial helmets. Their cities were Ur of the Chaldees, or Chaldaeans, where Abraham came from, Nineveh, Babylon, (Babel), Nippur, Nimrud, Kish and later Baghdad. We know them as Sumerians, Babylonians, Akkadians, Chaldeans and Assyrians. The ancient Semitic name of Babylon was Babili, "the Gate of the Gods".

Much of the alluvial gold of the Near East was usually electrum — naturally occurring *silver*/gold alloy. Pure gold was rare. Accepting a shekel was a gamble since the purity of the shekel (its silver or gold content) varied from piece to piece.

ASIA MINOR

From the earliest times, their predecessors and later the Hittites themselves mined silver in large quantities in Asia Minor. The Hittites were destroyed by about 1,200 B.C.

LYDIA

Lydia in Western Asia Minor with its capital at Sardis (Sardes), formerly Hyde, had always been a placer producer and was very rich in gold and silver (in electrum). The Lydians were probably of Indo-European Hittite origin.

The early Lydian coins, the world's first, from about 700 B.C. are of electrum, a gold-*silver* alloy occurring in nature. We still say in English "As rich as Croesus" (who issued them).

It was long thought that natural electrum was always about a maximum of 30 per cent *silver*, but an electrum with 50 per cent *silver*, with a maximum of 50 per cent gold, occurs in the mines that were worked by the Romans at Nagyag, Muczari and Vicus Pirustarum in the Banat of Transylvania, Romania, particularly in the period 97 to 106 A.D.

The weight of the coins from Lydia in the Temple of Artemis (Diana) at Ephesus built in 500 B.C. are remarkably uniform at 4.7 g., like the much later electrum coins of Lesbos and Cyzicus.

The source of the electrum of the kingdom of Lydia in Western Asia Minor was the river Pactolus, now called the Gediz or Sarabat. The gold-silver alloy was washed down from Mount Tmolus, now called in Turkish Boz Dag. The mythological King Midas ruled Phrygia, which eventually fell under Lydian domination. In the myth, everything he touched was turned into gold and he filled the Pactolus river with gold flakes whenever he bathed in it — an obvious reference to placer gold or electrum.

Croesus, King of Lydia in the Western part of Asia Minor, (Turkey), replaced electrum (gold alloyed to *silver*) coins with coins (staters) of "pure" gold and coins of "pure" *silver*. Croesus, about 560 to 546 B.C., reputedly the richest ruler in Asia, issued at Sardis, the capital, two "coins" in the form of crudely shaped oblongs, one gold and one *silver*. These coins have platinum-iridium inclusions.

They were stamped with a royal emblem — the heads of a lion and a bull facing one another. The stamp meant that the power and the wealth of the King of Lydia guaranteed the purity of their contents.

GOLD/SILVER RATIO

The weight ratio between the two was standardized by Lydia — thirteen and one third (13-1/3rd) *silver* coins were worth one gold coin — an early gold-silver price ratio on a weight basis.

Denominationally, gold was generally related to *silver* in a proportion of 1:10. Intrinsically, the ratio of value was 1:13.333. The distinction is important.

The ratios between one metal and another in the Middle East had varied even before coinage came. About 2700 B.C. it was 1:9. Around 1800 B.C., under Hammurapi of Babylon it was 1:6. By the 6th Century B.C. it had gone to 1:12 and for centuries thereafter remained between that and 1:16 except in China, which had more gold, where it was 1:6. In the time of Sargon of Akkad, gold was 8 times more valuable than *silver*. In the records of Mari it was 4:1, a higher value for silver than their trade with Ebla at 5:1. However for the greater part of the ancient history of Mesopotamia it was apparently 10:1.

In contrast, in Egypt, scarce *silver* was sometimes valued at times up to twice the value of gold. The Pharaoh fixed the gold/*silver* ratio as 2.5 *silver* to 1 gold.

A Celtic tribe, the Scordistae, who founded the city of Singidunum, now Belgrade, capital of Yugoslavia, in the Middle Danube region, were reported about 200 A.D. by Athenaeus as valuing *silver* above gold. Dunum is Celtic for fortress.

A few years earlier it was noted that the German tribes had the same preference for silver.

Following the discovery of America, the gold/*silver* ratio had become 1:14 by the end of the 16th Century A.D.

PERSIA (IRAN)

Croesus and his country, Lydia, were conquered by the Persians under Cyrus in 546 B.C. Cyrus of Persia captured Sardis, (old name Hyde) in Lydia, and adopted the bimetallic system with 1 gold coin equal to 20 of *silver*, 1:20. In building his palace at Susa, his successor, his nephew, the

Persian Emperor Darius, wrote about 2,500 years ago: "The gold was brought from Sardis (Lydia, Western Asia Minor) and from Bactria", (now Northern Afghanistan and Southern Uzbekistan and Turkmenistan, U.S.S.R.).

Under his successor, Darius, the Persian empire was vast — stretching from Greece to India. For this huge region, the Persian gold "daric" and the *silver* "siglos" (shekel) became the standard currency. Darius' portrait was stamped on the coins — a personal guarantee of the purity of the metal contained.

This Persian custom of rulers putting their own faces on coins, (and later on paper money), continues to this day. Modern customs are sometimes contrary. The British and Canadians use only *living* monarchs on paper or metal currency, but Americans use only *dead* Presidents.

The daric gold coin was not named after Darius, as the Greeks believed, but is derived from a Persian word meaning "gold"; in Middle Persian gold is called "zarig".

Cyrus and Darius allowed the Jews to rebuild the Temple of Jerusalem.

Gold is the first metal mentioned in the Bible and silver second. Strangely enough, almost no objects have been found of the six hundred years of the Israel period of Palestine (1200 to 587 B.C.).

The tabernacle (originally meaning "tent") built by the Jews had a sanctuary which contained much gold and silver, estimated as almost 5 metric tons of silver and about 1.5 metric tons of gold.

King Solomon of Israel, who ruled 3,000 years ago, used gold and silver profusely in the holiest place in the Temple, the inner sanctuary. The best estimate is that he was receiving about 18 tons of gold a year, a mind-boggling quantity equivalent to about U.S. $223 million nowadays at just about U.S. $400 an ounce.

Large quantities of gold were concentrated in King Solomon's hands and were dedicated to the construction of the first Temple in 967 B.C. and his palace. That Temple was destroyed in 586 B.C. and 50 years later Cyrus of Persia returned some of the treasures to the Jews:

"30 chargers of gold; a thousand chargers of *silver;* 29 knives; 30 basons of gold; *silver* of a second sort, 410; other vessels 1,000. All the vessels of gold and *silver* were 5,400." Ezra 1:9 to 11.

The gold objects of the Temple of the Jews were brought, after the 3rd or 4th Century A.D., as spoils to Constantinople, but they then disappear from history.

The troops of Sennacherib of Assyria in 701 B.C. overwhelmed the Judean Kingdom, which paid in tribute 30 talents of gold (1.5 metric tons) and 800 talents of *silver* (40 metric tons) and other luxury items.

GREECE, MACEDONIA AND THRACE

Silver was being mined in Greece and the Aegean islands from about 1,000 B.C. The early Greeks called electrum "white gold".

The Persians preferred to buy off their enemies, rather than fight them. The Greeks, often victims of this technique, had a word for it, "Medizing" — an interchangeable word for the Medes and the Persians, by then all in one kingdom. Later, Byzantium (Constantinople) used the same technique for centuries.

The Thracians, (and later the Greeks), worked the gold and *silver* deposits of the Mount Pangaeon region of Thrace, Thrake in Greek. Greek-speaking Macedonia could not be bought off by Persia because Philip of Macedon's wealth was based on the gold mines of Pangaeon and on the gold of the river Struma, both in a general area East of Pella, his capital, not far North of modern Salonika.

The systematic exploitation of northern Greek (Thracian) gold mines by Philip II made him wealthy and powerful.

The gold and *silver* mines controlled by Philip II also enabled him to drive the gold coins of the island of Cyzicus and the silver coins of Athens from the market. The silver drachma of Athens weighed about one-eighth of a Troy ounce and was stamped with an owl's head.

The independent country of the Thracians, (who spoke a language only dialectically different to the Greeks but who had no writing), began to strike coins almost as early as the Greeks and displayed much artistic skill on them.

Philip of Macedon had conquered a part of Thrace including the Pangaeon mines, by 341

B.C. He was murdered with a Celtic dagger in 336 B.C. His son, Alexander I of Macedon, conquered the Thracian Bisaltae tribe and adopted their native coinage, placing his own name on their coins. Alexander was taught by Aristotle, who was born in Thrace. Alexander made an accord with the Celts to secure his northwestern border before he invaded Persia.

Gold coins are not found in Europe until the coinages of Philip II of Macedon. Iron rods and *silver* had been the currency of early Greece. Philip II's gold stater was the first great gold coinage in the known world.

ALEXANDER THE GREAT

Under Alexander the Great, Persia was conquered in 330 B.C. Alexander's empire spread from Greece to Persia and to what is now the southern Soviet Union with its gold and *silver* mines and to the northwestern part of Pakistan and India.

Alexander regarded the known world's gold and silver supply as his own personal property. He was not conservative in the minting of gold and *silver* coins and issued them lavishly to his friends and to the ever-expanding army.

Alexander died at the age of thirty-two in Persia. Alexander's body was sealed in a glass coffin and ENCASED IN GOLD and preserved in Alexandria, Egypt, the city he founded as his own memorial, but the tomb has never been located.

Permanency did result, however. Alexander's currency, the "staters" and "drachmas", became the FIRST TRULY WORLD-WIDE CURRENCY. The Macedonian gold stater, (Greek word for "standard"), had a weight of 2 drachmae and a value of 20 drachmae.

2.2 NAMES FOR SILVER

SILVER — THE TEARS OF THE MOON

Silber	in German
Serebro	in Russian
Serbro	in Serbo-Croat (Yugoslavia)
Sarpu	in ancient Assyrian
Sa-ya, Sa-yama	in ancient Crete, Europe
Arizuma	in Aztec Indian
Kubabbar	in ancient Sumerian
Kasham, Kaspum, Kaspim	in ancient Babylonian
K-S-F	in ancient Egyptian (meaning "white gold")
KESEF	in ancient Hebrew
Ereint, Erient	in Welsh
Argead	in Irish, Scottish and Manx Gaelic
Argyros	in Greek (argos = white)
Argentum	in Latin
Argent	in French
Plata	in Spanish
Prata	in Portuguese

Those very earliest writings of man that have survived and are known to us use a word meaning both money and silver. The ancient Sumerian word for silver was KUBABBAR. In the successor Babylonian language, the word for silver was KASHAM, which was subsequently pronounced as KASPUM. The Egyptian word for gold was K-T-M in the hieroglyphs and Kidem in Early Minoan Crete, Europe. The similar Hebrew words were (for gold) Zahev or KETEM and (silver) KESEF, said to mean "to be white", the first word being perhaps a faint echo of KASHAM above. The Assyrian word for silver was SARPU. It begins with SA- like the ancient word for silver in Crete, SA-YA. Compare the sound of SARPU with Serbro in Serbo-Croat and Serebro in Russian. Also compare Serbro to the Serbs, (Srbri) whose ancient territory has always been rich in Silver.

The ancient names all describe silver's bright white colour.

Over in Europe, in Crete, the archaic word for silver was SA-YA or SAYAMA. The modern Greek word is, of course, ARGYROS, from Argos, "to be shining", related to Indo-European Sanskrit and the Latin word for silver is ARGENTUM from a root meaning "white and shining". The modern French word for both "money" and "silver" is ARGENT.

It is noteworthy that, in more modern Greek, the terms designating plants and metals, ("argyros" for silver, "chrysos" for gold, "chalkos" for copper etc.), as well as terms of navigation and fishery, have been borrowed by the Greeks from other languages. We still use these Greek words in technical literature in English. Greek is, like English, an Indo-European language but, to give other examples, the Greek word for king (basileus from which our word "basilica" derives), is also of non-Greek origin and so is the word "alphabet". The names of letters in Greek, alpha, beta etc., (hence "alphabet"), are mainly of Canaanite/Phoenician origin and the alphabet and the script itself may have been adopted by the Phrygians and the Greeks from Phoenician sources at a date around 1,000 B.C. Our alphabet letters are a Roman variation of the Greek script. The latter is the direct source of the Cyrillic script used in Russia, Bulgaria, Serbia etc.

Perhaps the most beautiful name for silver is the one the Incas used in Peru — "THE TEARS OF THE MOON".

The Aztec Indian word for "silver-bearing" is ARIZUMA, from which the name of the State of Arizona derives.

Our modern English word "silver" is of Gothic (Germanic) origin; Old High German "silabar" or "silbir"; Modern German is "silber". The word "silver" is common to both the ancient Germanic and Slavonic language groups. It is the related word "serebro" in Russian and "serbro" in the Serbo-Croat of Yugoslavia.

Before the Anglo-Saxons migrated to Britain, the Celtic Britons used their own very ancient word "argad" for silver. The Irish family name formerly transliterated into English as O Hargadane, O Hardegaine, O Hardagane and O Hargedan from the Irish Gaelic original O hArgadain, (but spelled in more recent times Hardiman, Harman and Harmon), means "descendant of a person called Argadan or Airgeadan", which is the diminutive form ("little silver") of Airgead, the Gaelic word for "silver".

The name Harman is now found mainly in south-east Ireland which is called Leinster.

It is an astonishing coincidence that the veteran New York precious metals firm that has published a daily silver price — widely accepted for a large part of the last hundred years — is called Handy and Harman.

There is a place in Ireland called Moyarget (Magh-airgid in the original Gaelic) which means "the plain of silver".

SILVER IN ENGLISH

The word silver was first recorded in the Germanic Anglo-Saxon language in 825 A.D., when Ecgbert of Wessex was King, (grandfather of Alfred the Great), as "sciolfur" or "soelfor". By 1175 the spelling was "selfre". Our present English spelling appears in 1340, "Of gold and silver gret (great) plenty". — Hampole, Pr. Consc. 4434.

Silver, in ancient Roman times, was also called Luna (with the crescent moon as its symbol), or Diana — for the famous hunting and nature goddess, patroness of silversmiths — in the same way as we use the word mercury for the metal quicksilver from the Roman name of that god. Diana was the chastest of the ancient goddesses and was equated with Artemis in the Greek world.

> "Lady, by yonder blessed moon I swear,
> That tips with silver all these fruit-tree tops."
>
> —Shakespeare, "Romeo and Juliet"

Women favoured the goddess Diana and her symbol, Silver. Medieval alchemists called silver Lunia.

The Latin name for silver, argentum, means "bright and shining".

Strasbourg, France, was known in Roman times as Argentorate; Colmar, Alsace was known as Argentaria and an archaeological site east of Poitiers was the ancient Celtic settlement called Argento-magus. Magus is Celtic for a plain. Nowadays in France, there are Argentré du Plessis, Brittany, Argenton, Brittany, Argentan, Normandie, Argentat, Argenteuil, Argentière, Argentieres, Argentine, Argentré and Argent.

Roman Mount Argentarius on a peninsula off Etruscan territory is now called Mt. Argentario. The name does not mean that silver mines were there but rather that, after Etruscan independence was ended, the great Roman land-owning families of the Domitii had their bankers (argentarii) there.

Canada has Rivière à l'Argent, Quebec, Argenta, British Columbia and Argentia, Newfoundland.

The Spanish word for silver is "plata". Our word platinum derives from it. The Spaniards did not know what the strange white non-corrodible metal found in South America was and so called it platina, meaning "little silver" in Spanish.

THE PRESTIGE OF SILVER

The Silver Wedding Anniversary is celebrated at the end of the 25th year of marriage.

Ingots of silver occur in the shield of arms of the borough of St. Helen's, Lancashire in England.

Ingots of gold appear on the arms of the Woollan family.

A.D. 90-120, when Tacitus, Juvenal and Martius were writing in Latin, is known as the "Silver Latin" Period. In English, we still say of an eloquent speaker, "He has a silver tongue" and of others, "He was born with a silver spoon in his mouth", phrases that date back to the mists of early history.

The coast of the Arcachon basin in the Bordeaux area is called "the pearl of the Côte d'Argent", (The Silver Coast).

The summit of French cuisine is the ancient La Tour d'Argent (Tower of Silver) restaurant in Paris.

It might be noted that in the U.S. Armed Forces, the silver form of an insignia of rank is almost entirely used to denote the *higher* rank compared to the gold form, as follows:

	SILVER	GOLD
General of the Army	circle of 5 silver stars	
General	4 silver stars	
Lieutenant General	3 silver stars	
Major General	2 silver stars	
Brigadier General	one silver star	
Colonel	silver eagle	
Lieutenant Colonel	silver oak leaf	
Major		gold oak leaf
Captain	2 silver bars	
First Lieutenant	one silver bar	
Second Lieutenant		one gold bar

2.3 ANCIENT SILVER ARTIFACTS

Silver ornaments have been found in tombs dating back to 4,000 B.C. More than 200 silver artifacts found at Byblos, Lebanon date from about 3,500 B.C. A silver vase from Chaldea is dated as 2,850 B.C.

The Early Bronze Age (I) in the Eastern Mediterranean extends from about 3,500 B.C. to about 2,900 B.C. and the second phase (EB II) from about 2,900 to about 2,100 B.C. The Middle Bronze Age ended about 1,700 B.C.

In the Bronze Age, silver was used mainly for jewellery, (necklaces, bracelets, rings etc.), but also to make bowls and cups.

Silver ornaments and jewellery dating back to 2,500 B.C. have been found all over the Mediterranean area. An elegant silver cup from Gournia, Crete, Europe dates from 2,000 B.C.

Pre-Hittite graves of about 2,487 to 2,473 B.C. at Dorak, near the Sea of Marmora, northwest Turkey, yielded a silver dagger about a foot long, two silver lance heads, a silver diadem with pendants, silver ear-pendants and two silver bracelets.

More importantly to us, silver's main use (by weight) was as an early form of money.

2.4 SILVER AS MONEY

Silver and gold are the raw materials of true money.

Silver has its own rich history, in money, in trade and in the arts. It continues to hold a very special place in the heritage of many countries and cultures.

Silver has always been money. The human race has never known a time in history or in much of pre-history when it was not. Its main use in ancient times was as the first "money", in a practical circulating sense.

All the ancient units of value were weights (of silver and gold).

Silver had always been used as money from the very earliest times in the shape of bars, ingots, slugs and rings, which were weighed in balances in a system of weight which was established at least by the time of the ancient Babylonians and almost certainly their predecessors. This use of silver as money was well established by about 2000 B.C.

The Egyptians traded with small rings of gold and silver and with bars of gold and silver.

Circular coins or slugs of silver and gold were eventually developed around 700 B.C. by the state of Lydia in Western Asia Minor, a development from the trading in pellets of silver, cast in small pieces. About the same time, silver was used in China and India as money, perhaps 1,000 B.C. in the case of China.

Silver (and gold) still enjoy popularity as the "true" money because

1) nature itself severely limits the amounts of silver (and gold) that can be mined profitably to a very small proportion of existing world money stocks. SILVER AND GOLD BULLION CANNOT THEMSELVES BE COUNTERFEITED and NEITHER CAN THEY BE ARTIFICIALLY INCREASED IN TOTAL PHYSICAL TONNAGE.
2) silver and gold are
    a) desirable
    b) scarce
    c) consistent in quality
    d) durable
    e) divisible
    f) convenient
    g) have served as a "store of value" throughout the last six thousand years.

Well over 250 million people in more than 50 countries use the same word for silver as for money. Silver literally means money in French and Spanish.

Silver still is "real money", as gold is. It is one of the few forms of "hard" money and is as respected as it was in the days of Abraham and probably more so by hundreds of millions of people in the world today.

The most popular silver coin in the Middle East and Eastern Africa these days is the Maria Theresa dollar, which is still traded in vast numbers in the Middle East as the only money of any kind that many people will trust. It is the original model for the Spanish dollar, the Mexican dollar and the U.S. dollar coins. It is still produced in Vienna in formidable numbers — with the original date, 1780, on them. The demand for them has never ended.

In Eastern Africa, Ethiopia retained the Maria Theresa silver dollar and eventually it also became the trusted money of the British and Italian colonies in East Africa.

SILVER NEEDS NO-ONE'S SIGNATURE TO MAKE IT VALUABLE.

NO GOVERNMENT CAN CHANGE THAT REALITY — except to deprive its own citizens of possession of either or both metals for a number of years.

Historically, the pattern has been that governments have either eventually given back to individuals the freedom to own these "money" metals, or have been submerged themselves, nation after nation, empire after empire.

Abraham paid Ephron the Hittite by weighing out 400 silver shekel weights, "current money with the merchant", to buy a burial site for his wife Sarah from a Hittite clan somewhere around 1,800 B.C. The word "money" is interpolated by the translator into English. In Hittite, (the oldest known Indo-European language), the word for shekel is GÍN.

THE MONEY OF MERCHANTS

Gold remained the monopoly of kings and priests, but silver, being generally more plentiful in the Middle East than in Egypt, became the currency of merchants in trade from at least 3,000 B.C. in Mari and Ebla in the Levant and Mesopotamia. It was traded by weight. Five ounces of silver were worth one ounce of gold. The Babylonian King Hammurapi, the great Law Codifier, c. 1,700 B.C., speaks of "silver" with a value determined by weight and quality. From 1,670 B.C., the gold/silver price ratio ranged from 8.93 to 18 to 1.

Lydia, as mentioned previously, was the first country to produce coined money, in electrum, a natural alloy of gold and *silver*, about 600 B.C. Lydia in Western Asia Minor, (now Turkey), whose capital was Sardis, had always been productive and rich in gold and silver. The Lydian king Croesus, who minted the first known silver and gold coins, is still a symbol for immense wealth, in our language.

In the rabbinic tractate, "Women", there is a section, "Marriage", which states that any of the three following acts cements wedlock:

1) silver (for example the payment of some

"bonum" such as silver). The word used, kesef, means silver or money.

2) the writing of a marriage contract ("Star" in Hebrew)
3) sexual intercourse between the eligible man and woman, as the ancient story of Boaz and Ruth of Moab (great-grandmother of David), widow of a Judean of property. A child born to Ruth would be the legal heir. This was part of the ancient Northwest Semitic tradition.

SHEKEL

A Semitic unit of weight to measure gold and *silver* and later on, a coin of that weight. Biblical references are to uncoined ingots, often of electrum.

In Babylonia, small pieces of gold weighing 8.34 grams each were known as shekels centuries before the Lydian coins. In the Middle East, a gold weight (or later a coin) called a "shekel", a standard unit of measure, (originally weighing 11.3 g.), was in use long before the time of Croesus, (560 to 546 B.C.). It is mentioned frequently in the Bible; developed as a standard weight of about 16.4 g.

The early "sealed shekel", a stamped piece of *silver*, came very near to being a coin, in the way it was used.

The Mesopotamian shekel was 129 grains, based on the barley grain.

The Hebrew gold shekel weighed about 16.4 grams, each carrying a value of 13.33 *silver* to 1 of gold.

The shekel weight was one fifteenth or one sixteenth of a mina and about one three thousandth of a talent. About 60 minas went to the "talent", heaviest of the standard weights. A mina was about 1 pound in weight.

Shekel silver coins were first minted around 141 B.C. In Roman times the shekel was not only a coin but a symbol of Jewish sovereignty under a Jewish king, albeit under Rome. However, by the time of Jesus, when he asked people to show him a penny, almost certainly a silver denarius, it was the image of Caesar on it that was his point.

The Babylonians cast shekels in the shape of a sleeping duck and the Assyrians preferred the shape of a lion.

The word shekel is derived from Hebrew "sagal", weigh. In Greek it is "siglos". It became, by transfer, siglos in Persian.

The new unit of currency in Israel (1980) is the sheqel, (shekel), about 25 U.S. cents in value then, but in early November, 1984, a dollar bought 500 shekels (paper money).

2.5 SEPARATION OF SILVER FROM GOLD IN GOLD-SILVER ALLOYS FOUND IN NATURE

Techniques to separate gold and silver, e.g. in electrum, a gold-silver alloy found in nature, started to be developed about 2,000 B.C.

2.6 HIGHER VALUE FOR SILVER

In many areas of the ancient world, silver was considered more precious than gold. Silver was highly prized in Egypt in ancient times, being valued at more than gold on occasion between the 30th and 15th Centuries B.C., because there was virtually no domestic mine production of the metal. They called it "white gold". Gold-rich Egypt had to import all of its silver and copper and the silver may have come from Syria or Asia Minor.

2.7 ANCIENT SILVER MINES

As far as we can presently determine, the earliest known mine production of silver in any noticeable volume took place in Cappadocia in Eastern Asia Minor, (now in Turkey), by the predecessors of the Hittites during the period 4,000 to 3,000 B.C. The Hittites, later large producers of silver, spoke the oldest known Indo-European language.

Their word for silver was written as an ideogram which was the name of their capital city, Hattusas. Around 3,500 B.C., the silver/gold price ratio was about 1:3 or 1:2.5 in Egypt. About 3,000 B.C., rulers in the Middle East were buried with objects of silver.

The silver-lead deposits at Hissarlik, (Troy), Western Asia Minor, (Turkey), were probably worked as early as 2,500 B.C. and lasted for many centuries. (See the 2,000 B.C. Treasure of Priam summary in the Glossary Appendix.) Other ancient silver mines were in Spain, Sardinia, Tuscany, Greece, Bohemia, Romania, Asia

Minor, Armenia, Nubia (now Sudan), Ethiopia, Persia, India and China.

If you look at a map, it is interesting to note that the mine sources of silver conveniently available to virtually all of the ancient European and West Asian civilizations stretch in almost a straight band from Spain, Sardinia, Tuscany, Yugoslavia, Greece, Romania, Asia Minor and Armenia to Afghanistan, running roughly west-east.

Silver metal was probably obtained from the reduction of lead-silver sulphides and from electrum in those early times.

From at least 1,000 B.C., there were extremely important silver-lead mines at Laurion (Laurium), now Lavrion, about 30 miles from Athens, near Cape Sunion, (Sounion), close to the southeastern tip of mainland Greece. They eventually stretched a distance of some 8.5 English miles from Anaphlystus (now Ergasteria) to Thorikos and all were fortified. Imagine mines being fortified nowadays. They were not fully or systematically developed until about 500 B.C., when they greatly contributed to the wealth of Athens. For some 300 years, Laurium silver financed the Greek wars, particularly the vital war of 480-479 B.C. against the massive Persian invasion. In all, an estimated 250 million troy ounces, (about 7,800 metric tons), of silver were mined at Laurium.

The dominant position of Athens in the 5th Century may have been largely due to the fact that the city-state controlled the two main mine sources of silver bullion accessible to the Greeks, i.e. Laurion and Thasos.

Athens was a city-state society rooted in silver.

The profits on selling silver to a Greek trading world with a silver standard and a silver currency must have been very great.

One can say with confidence that Greek civilization and therefore Southern European civilization was saved from absorption and decay under oriental Persia primarily by the wealth from those silver mines although that fact may be considered by some to be less inspiring than the bravery and cunning in battle of the Greeks and their allies. It took both silver and valour.

Many ancient silver artifacts from the Eastern Mediterranean and Egypt have been examined with the most modern methods and in the great majority of examples from all over that area examined by one group, the isotope is that of Laurium-origin silver.

By about 1,000 B.C., silver had been mined both in Greece and in the Aegean islands.

The island of Siphnos, (now Sifnos), off the southern tip of mainland Greece, was a famous source of silver in classical times and its isotope has also been identified in some ancient silver artifacts. The Greek island of Kimolos (Chimoli) was yet another important source of silver.

The Satrae, a Thracian people, in remote times worked the gold and silver mines at Mount Pangaeus (Pangaion), near the Aegean coast in what is now northern Greece.

Philip II, King of Macedon from 356 B.C., conquered and exploited the silver and gold mines of Mount Pangaion, largely to pay his army, which his son, Alexander the Great, led to conquer Persia. Philip was the first unifier of Greece.

ALEXANDER TOOK OVER 907 METRIC TONS OF SILVER AND GOLD BULLION AND 227 METRIC TONS OF GOLD COINS FROM THE ROYAL PERSIAN TREASURE AT SUSA, ECBATANA AND PASAGARDAE.

The silver tetradrachm coins of Alexander were minted in Amphipolis in Macedonia and in Babylon, Mesopotamia and silver drachms at Miletus and Lampsacus in the Hellespont.

The return of spoils to Macedonia and Greece, including gold and silver bullion and coins, greatly stimulated trade and commerce.

The Celts of remote times mined silver in what is now Czechoslovakia, Yugoslavia and Romania.

The Bible mentions silver spoons in the story of the building of the Temple, as well as many other silver artifacts elsewhere.

SILVER REPLACED BY GOLD COINS FOR ABOUT A CENTURY

The currency of early Greece was silver until Alexander the Great's father, Philip II of Macedon, issued the first gold coins in Europe. These were called "staters", the Greek word for "standard", probably promising a standard weight of pure gold and therefore standard value. His was the first great gold coinage in the known world.

Later on, silver mines were developed further east in Armenia and south of Bukhara, (Bokhara), (both now in the Soviet Union), and in Bactria, (now in Afghanistan).

SPAIN

The next area was also extremely important. From at least 450 B.C. it belonged to the combined Celtic and Iberian (Ebro river) tribes, who called themselves Celtiberians, in Southern and Eastern Spain whose silver-lead and other metal in mining operations were significant.

As early as 2,900 B.C., metal workers in that area were mining and producing cast copper and arsenical bronze tools. Some authorities even maintain that Tartessus in Southern Spain was the Tarshish of the Old Testament from which silver, iron and lead were brought by sea to Tyre in Phoenicia, north of Israel, before 600 B.C., (Ezekiel xxvii.12).

Silver was being produced by the Iberian tribes in Spain between 1,200 and 1,100 B.C. at Rio Tinto.

Diodorus Siculus, writing at the time of Augustus, said "The land of southern Spain contains more numerous and more productive *silver* mines than any other area. The Phoenicians from Lebanon, (and their colony of Carthage, Tunis), on their trading voyages acquired *silver* in exchange for a small amount of merchandise. Carrying this to Greece, Asia and other countries, they gained great wealth".

CARTHAGINIAN TAKEOVER OF SPAIN'S MINES

The Celtic-Iberian rich silver-lead workings in Spain were seized in the period 236-228 B.C. by armies from Carthage under Hamilcar Barca. Carthage is now a ruin near Tunis, North Africa and was originally a Semitic colony from Phoenicia, (Lebanon). The silver enabled Carthaginian power to expand in the Western Mediterranean. Rome became covetous.

Rome badly wanted the gold and silver wealth of these mines.

ROMAN TAKEOVER OF SPAIN'S MINES

Conquest of the Etruscans in NW Italy gave Rome possession of at least some of the gold and silver mine sources in the Italian peninsula and Sardinia.

After long years, Rome finally triumphed over Carthage in Spain (Hispania in Latin) by 206 B.C., completely destroying Carthage itself in 146 B.C. Only 2 tons of silver were found in the city. No gold is mentioned. Only 50,000 of the inhabitants survived and they were sold into slavery.

Roman administrators in 206 B.C. quickly took over the long sought Spanish silver and gold, mercury etc. mines and greatly expanded output by the ruthless employment of large numbers of slaves from Africa, (then the Latin name for the Carthaginian part of the Southern Mediterranean coast, although we now apply the word Africa to the whole continent), as well as other enslaved peoples acquired in battle or by purchase from various parts of Europe in exchange for Roman wine, table vessels, etc.

In the 300-200 B.C. period, Rome absorbed the Etruscan cities and their rich silver, gold, copper, iron etc. mines in Central Italy.

The Greek and Asia Minor mines gradually came under Roman rule during the 200-100 B.C. period.

At the height of the Roman Empire, 117 A.D., it owned all of the mine sources of gold and silver in the known world — in Britain, Gaul, Spain, Morocco, Sardinia, Italy, Yugoslavia, Macedonia, Thrace, Greece, Asia Minor, Syria, Armenia and Arabia.

ROMAN MONETARY SYSTEM

Silver became the main basis of the money system of the Roman Empire and most of this Roman silver came from slave labour in the mines of Spain. The output of the Spanish silver and gold mines was one of the greatest economic landmarks in Rome's long history. (Incidentally, silver had not been coined in Rome until as late as 269 B.C., which might indicate a shortage of silver before that, remedied by the slightly earlier takeover of the numerous Etruscan mines by Rome by 282 B.C.). Metal mining had been the creator of the Etruscan city-states and civilization and much of this was adopted by the Romans.

Rome gradually adopted the Carthaginians' love of luxury goods from the East, India, Ceylon, etc. — spices, silks, fine cottons, ivories and jade. The Carthaginians had inherited the trade from their forebears, the Phoenicians, who built it up in the 2nd millenium B.C. The spices were particularly vital to the increasingly fastidious tastes in Rome because of the difficulties of storing food such as meat, particularly through the winter. The Romans took over the Carthaginian Eastern and Mediterranean trade and greatly increased it.

This caused more and more silver to flow to India from the Spanish mines to pay for it. This trade did not end until about 700 years later, following the fall of the Western Roman Empire (Western Europe) to German tribes in 476 A.D. and the later Arab conquests of Spain from 711 A.D. etc.

In the later Roman Republic and Empire, ornamental silver plate was avidly collected. Army commanders used to travel on campaigns with lavish supplies. Some of it has been recovered from places where it had been hidden for safety. The famous hoard found intact at Mildenhall, near Cambridge included the finely chased and engraved silver Great Dish and the silver platter, bowl, goblet and spoon. See Appendix II, 313 A.D. and 50 B.C., the Hildesheim Treasure Hoard.

ROME — COINAGE

The Roman gold coin was the "aureus". They were standard throughout the vast Roman empire.

The "aureus", (aurum is Latin for gold), a gold coin, originated before Julius Caesar, first Emperor of Rome; initially one-fortieth of a "libra" (a pound weight) — say 126 English grains per aureus. Size was between the modern U.K. sovereign and the old U.S. 5-dollar piece.

About 25 "denarius" 60-grain *silver* coins were the equivalent of 1 "aureus", but no effective ratios really existed in the Roman Empire.

The currencies in many of the modern countries of the Muslim world are still called "dinars", (from that name of the Roman coin), e.g. in Algeria, Tunisia, Libya, Jordan, Iraq, Kuwait, Bahrein and South Yemen, as well as Yugoslavia, where part of the population is Muslim.

The early Emperors consistently debased the coinage, circulating lead or copper slugs plated with silver or gold and passing them off as the original silver denarius and the gold aureus.

By A.D. 268, the silver content of the denarius coin had fallen to 1/5,000th of its original level, no good silver or gold coins were in circulation — Gresham's Law — and inflation and subsequent state intervention in the economy had become so bad that poor men and rich prayed that the German barbarians would deliver them.

From the early 300's it had been necessary to assay and weigh each coinage piece used in circulation as money, they were so debased.

The historian Antoninus Augustus said: "Money had more to do with the sick state of the Roman Empire than the inroads of the Huns or the Vandals."

Constantine, declared Caesar by the army in York, Britain, in A.D. 306, was the victor in the long civil war in Western Europe and became undisputed master of Rome and the West by 312. Constantine I was born at Naissus, (now Nis in Serbia, Yugoslavia).

Constantine came out in favour of Christianity from 313 A.D. which enabled him to seize the treasures held in trust in the pagan temples throughout the Empire.

THIS PUT VAST STOCKS OF SILVER AND GOLD BULLION IN HIS HANDS AND THEREFORE GREATLY INCREASED POWER.

He defeated his last rival in the East in 324 and ruled as sole Emperor in the East and West.

BYZANTIUM — THE EASTERN ROMAN EMPIRE

The Roman capital was moved to Byzantium in 325 A.D., renamed Constantinople after the Emperor. (It is now called Istanbul, the Turkish pronounciation of that name.)

The Roman Emperor Constantine reformed the currency, creating a new gold coin piece, the "solidus" or "nomisma" or "bezant" (from the old name of the city), containing 4.2 grams of gold (65 grains), 72 coins to the Roman pound (librum) of gold.

The standard coin of the early Empire, the silver denarius, was progressively debased until, between A.D. 324 and 360, it depreciated from 4,350 to 4.6 million denarii to the new gold "solidus" coin, itself one of the most stable monetary tokens in economic history. The basis of the East Roman financial system was the steady supply of a standard gold coin.

From the designation of Byzantium in the mid-300's A.D. as the seat of the Roman Emperor right down to the 600's, no new silver coinage was issued, indicating perhaps the capital's relatively short-lived loss of control of silver mining areas.

Under the name "bezant", the solidus was accepted in trade from Africa across to China and from Ceylon to the Baltic and England. THE COIN RETAINED ITS FULL VALUE FOR NEARLY EIGHT HUNDRED (800) YEARS until Italian gold coinage was introduced in the 13th Century by Florence and Venice.

The weight of the "bezant" gold coin was significantly close to that of the Athenian or Attic *silver* "drachma", the great unit of account in the ancient Greek world.

The bezant was famous for its extraordinarily high purity from the Fifth Century A.D. down to the Eleventh.

THE BYZANTINE GOLD AND SILVER HOARD

Byzantine Treasury assets, (during the regency of Theodora): about 50 tons, comprising, 1,100 centenaries of gold and 3,000 centenaries of *silver* and 200 centenaries of gold in other items. *Silver* was valued at about 14.1 to gold.

MINE CONDITIONS UNDER THE ROMANS

Silver and gold mines belonged to the Imperial Roman government, but were usually contracted out for operation by civilian lessees called "publicani". They were held responsible for delivering the gold and silver revenue to Rome.

The treatment of slaves working the mines was brutally harsh. No matter whether they were guilty or innocent by modern standards, those unfortunate thousands who were condemned to the Roman mines, i.e. condemned "in metallum", (meaning "to the mines"), all went through the same horrible initiation, whether they were actually from gangs, or were brutal criminals or were political or religious prisoners, such as Christians. They were usually sentenced for a minimum of ten years of hard labour in the mines. Only a rare few survived for ten years.

Their induction as slave miners was routine. With all of them, (both men and women), the typical initiation was as follows — the left eye was gouged; the socket was cauterized with a hot iron; the joints of the left foot were burned; all were branded with a number on the forehead; iron rings were welded around the ankles and linked together by a six-inch chain; a tight chain was placed around the waist; a third chain attached the waist chain to the ankle chain in such a way that the prisoner would always be stooped over, (their normal working position). Once branded and chained, each prisoner was given a routine sixty strokes of the lash and put to work in the mine.

As a general rule, perhaps something like an estimated two-thirds of each new batch of prisoners could be expected to live for very long afterwards. That was acceptable. The strong survived.

Out of each 24 hours, they typically worked up to four 5-hour mine shifts and had four 1-hour rest periods — and that was 7 days a week, week after week. One meal of coarse bread and water a day was typically their only sustenance. The guards were quite pitiless, usually mercenaries chosen from far places in Asia and Northern Europe, understanding barely enough Latin to take orders from the Roman officers. When prisoners were no longer able to work in the mines, they were executed at the neck by a sword stroke from one of the guards and thrown into pits.

The Romans were unrelenting calculators. For example, in Spain they calculated that the amount of mercury, (a metal vital in their use of gold), that a slave could carry in one load, day after day, month after month, was the equivalent of 76 English pounds — and 76 pounds is still the unit for trading mercury (also called quicksilver) to this day.

With all of this relentless organization and activity, precious metal production kept on coming forward, whether from lead-silver ore or gold ore, and output of other metals too from iron ore, copper ore etc. from the many mines of the Roman Empire.

Beautiful objects were made from these metals, silver, gold, lead, copper, bronze, etc., some of which can be seen in the great museums of Europe today.

It is somewhat shocking to realize that some of the total gold and silver that has ever been mined and which is still visible to human eyes has been the product of particularly severe or at least distressing mining conditions in ancient Egypt, Nubia, Arabia, Spain, the Balkans and Greece. Severe mining conditions can also be found today; consider two of the principal modern source countries, South Africa and the U.S.S.R. In South Africa, black labour, recruited largely from tribes in neighbouring countries, has for decades provided the bulk of the work force in the world's deepest and hottest and most humid mines. In Russia and later the Soviet Union, conditions in the dreaded Siberian open mine workings in the coldest regions in the Northern Hemisphere cannot be imagined and they contrast with those in the same country, for example, in the shallow open pit operations in the intense heat of the desert of Kyzyl Kum, (qizil, red; qum, sand, in Persian), in Soviet Central Asia.

SILVER MINES IN SPAIN AND PORTUGAL KNOWN TO HAVE BEEN WORKED IN ANCIENT TIMES.

District	**Province**
Bebulo (Guadalcanal)	near Cordova
Carthago Nova	Cartagena, Murcia
Sierra Morena	mountains of Jaen
Pyrenees mountains	Aragon
Rio Tinto	Huelva

Gaul (France)

The Romans also discovered that, in Gaul, the Celtic Ruteni tribe of Rouergue and the Gabales tribe, (which has given its name to Gevaudan in the Pyrenees mountains), near Celtic Narbo, (modern Narbonne), possessed valuable silver mines and so Rome took them over too. The Celtic Tarbelli tribe of Tarbes, (a modern echo of their name), Hautes-Pyrenees, Aquitania, had the richest gold mines and the more famous Celtic Tectosages tribe had mines in a district rich in gold west of the river Herault (anciently Arausis) on the NW flank of the Cevennes mountains in Aquitania. The Volcae Tectosages were a major Celtic tribe with their capital at Tolosa, (Modern Toulouse, now the 4th largest city in France). The enormous accumulation of gold and silver treasure of the Tectosages tribe was seized by the Romans. The Tectosages were one of the three Celtic tribes who founded Galatia (Gallic-land) in what is now central Turkey — the Galatians of the New Testament.

Eastern Europe

The next important centres of silver output were in Eastern Europe in the mountains of Transylvania (now in Romania) and of Bohemia (now in Czechoslovakia) and in Germany, particularly from the Middle Ages onwards.

The Muslim Empire

Other than Spain, virtually all of the Muslim Empire's silver mine locations around 800 A.D. are now within the Soviet Union's boundaries in the general Samarkand and Bokhara area, (seized by Russia as recently as 1868 and which still remains largely Muslim and ethnically Turkic in origin).

Western Europe

Early in the 2nd Century B.C., the Celtic Gauls in France, the Celtic Britons and the German tribes began to strike independent coinage issues of silver and gold, based frequently on distant Greek models. In Britain's case, this was up to two hundred years before the Romans arrived. One of the many fictions in schoolbooks and histories is that the Romans introduced virtually all civilized things into Celtic Britain, France and Spain, including precious metal coinage. Of course, it was not and is not correct. Take one example, as follows.

Britain and England

During the 100 years or so before the Roman conquest of Southern Britain of 43-5 A.D., the Cotswold Hills of Gloucestershire, Worcestershire and the county of Avon in the southwest of England and their surroundings as far south as the lower Avon river, were occupied by the Celtic Dobunni tribe which was ruled by a Celtic Belgic aristocracy. Avon is the Celtic word for river. Their two divisions were Bodvoc (Bodwok), the northeast Dobunni and Corio, the southwest Dobunni, who had a mint. Their capital Corio is now called Ciren-cester, anciently Corinium Dobunnorum in Latin. The suffix Cester is a later Roman addition meaning a military camp.

The Dobunni's Corio mint issued its own fine gold stater coins in the Greek-origin Gallo-Belgic style well before Christ and well over 100 years before the Roman legions occupied Southern Britain. One was found in Bristol in 1955 and another in 1968. At least 50 Dobunnic silver coins have been found during the last hundred years alone.

Silver was extracted by cupellation from lead ores. Much of the mined silver was retained officially for use by the mints as coins.

Further to the south, Dorset, West Wiltshire and East Somerset County, including the Mendip Hills to the north, were occupied by the Celtic Durotriges tribe which also issued silver coins long before the Romans came. The metal was almost certainly obtained from the silver-lead workings at a place which is now called Charterhouse-on-Mendip. Ten of these fascinating silver coins were found in 1905 and many others since.

In Eastern Britain, in the first century B.C. long before the Romans came, the kings of the powerful Celtic Catuvellauni confederacy, Tasciovanus and his son Cunebolinus (the Cymbeline of Shakespeare) issued excellent gold and silver coins with inscriptions in Celtic. Their territory was East Anglia north of the river Thames, with their capital at Camulodunum, (also rendered as Camelot), near Colchester. They paid for imports of foreign goods by exporting silver, gold, iron, hides, slaves and hunting dogs.

North of them, in what was to become Norfolk and Suffolk, the Celtic Iceni tribe also issued gold and silver coins and over a century later, Boudicca (Boadicea) became their famous Queen, who fought so bravely against the Romans.

The Belgic Celt settlers left silver brooches in their graves in Kent.

One large metal ingot or pig, weighing about 180 pounds, from the 360-year Roman occupation of southern Britain, is stamped with the date of 59 A.D. and "British lead from the *silver* mines of Graius Nipius Ascanius" and is probably from the Mendip hills in Somerset.

It was not only the shortage of gold, which developed from 700 A.D., but the rooted preference of the northern European peoples for silver and the requirements of internal trade, which led to the predominance of silver. The preference of the Germans for silver had already been mentioned by Tacitus in the first century A.D. and the same preference was shown by the Saxons of Britain. In the 600's, Britain abandoned gold and issued silver coins called sceattas.

In the early half of the 7th Century, Anglo-Saxon kings in England began to mint their own silver coinage. The earliest are those of King Eorpwald of East Anglia about 616-628. His conversion had been influenced by Aeduin (Edwin) King of Northumbria. The Frisian merchants from Dorested near Utrecht who traded in London and York spread the use of silver pennies outside Great Britain and imitated them in their own mints, notably in Duurstade when, in the 8th century, gold coins had become a rarity in France. Gold jewellery became scarce in England.

Among the earliest Anglo-Saxon coins which can be identified with certainty are some silver pieces marked with the name of King Aethelred of Mercia, West Central England, 675-704 A.D.

However, there are others of the same type and standard, about 21 Troy grains, which may be of his father Penda (died 655).

Regular silver coinage was definitely in use there at least in the early 600's, according to the laws of Aethelbert and many unidentified silver coins may date from the 500's and these are fairly numerous. Their weight varies from 10 to 21 grains.

In the early Anglo-Saxon laws the money actually in use appears to have been entirely silver.

The silver in the coins was never adulterated in those days.

From about 775 A.D., the Anglo-Saxon kingdoms in England issued "sterlings" or "penny" silver coins, 240 being equal in weight to the pound, originally "a pound of sterlings". Silver pennies were the only English coins until the 13th Century.

The high purchasing power of an Anglo-Saxon silver penny may be illustrated as follows:

> 30 silver pennies was the legal price of an ox;
> 4 to 5 silver pennies was the legal price of a sheep.

In the time of the Anglo-Saxon King Offa of Mercia and later King of England, (d. 796 A.D. after a reign of 39 years), a new gold coin, a mancus, was introduced by him, adopted from Muslim countries — with a faithfully copied Arabic inscription. He presumably did not know that this read: "There is no God but God and Muhammad is his prophet." It resembled the Roman solidus coin of about 70 grains in weight.

Originally, in England the world scilling (or shilling) seems to have been a word for gold coins — as distinct from silver — but with a disappearance of gold coins owing to the gold shortage, it came to denote a mere unit of account. Illustrating the shortage, the value of gold relative to silver was 10 to 1 at the close of Offa's reign, but it was 5 to 1 or 6 to 1 at the start of his long reign.

The Anglo-Saxon Kings had provided themselves with the best currency in western Europe, small thin pennies, neatly designed, competently executed and made of good silver.

Silver pennies in great numbers have survived from the late Saxon Age. Men buried hoards of coins when danger approached and often did not live to dig them up again.

Silver and gold finger-rings, armlets and collars were worn by the Anglo-Saxons. References to saddles adorned with silver and gold occur.

The Saxon kings deliberately decentralized the actual coining of money and decreed that every borough should be a minting place, which meant that there was an exchange to which bullion could be brought for sale in every borough. Each was a nucleus from which coined money went out to assist in the circulation of goods in its area and to percolate into the remoter regions in and out of the country.

Silver pennies bore the king's image and name on one side and on the other the name of the moneyer (coin maker) and the place where he worked. These were in effect royal agents and had to realize their responsibility. From King Athelstan's day, in the 900's, a moneyer convicted of striking (minting) bad (impure) silver money had his hand cut off and pinned up on the smithy of his mint. About 200 years later, Henry I had to summon the moneyers who had issued bad silver pennies to Winchester in 1125, where their right hands were cut off and they were emasculated.

The British currency unit, the pound, was originally, in Anglo-Saxon times, "one pound (weight) of silver", a unit of account. The weight was traditionally that of "32 wheat corns, (grains of wheat), in the centre of the ear". Alfred the Great, King 871-899 A.D., probably used a pound which weighed something close to the later French Troy pound, which was 12 Troy ounces or 373.242 g.

The early weight in England, the Saxon pound, was later called the Tower pound, i.e. 5,400 grains, the weight of a pound of silver. Later, in the 1520's, French Troy weight was officially introduced in which the Troy pound weighs 5,760 grains. It had been used in England from 1415 A.D. and became the English legal standard for silver and gold in 1527.

However, gold had gradually become scarce in Western Europe from around A.D. 700 and the scarcity continued until about A.D. 1200. Gold currency became impossible, causing a switch to silver and even gold jewellery became very rare.

From the 9th to the mid-13th Century, gold was so scarce that, in the main, very few gold coins were minted in Western Europe, but the gold bezants of Constantinople (Byzantium), capital of the Eastern Roman Empire, circulated all over the continent.

In England in the Middle Ages, the Exchequer rolls show that payments in "bezants" were the ordinary thing where gold was used. (Thomas Madox, History of the Exchequer, 1769.) Understandably, European princes and feudal lords rarely minted gold coins themselves.

A major cause of that scarcity was the commercial growth of the Eastern Roman Empire — unaffected by the collapse of the Western half which had come under German conquests. The importation of luxuries from the East into Constantinople (Byzantium) the Eastern Roman capital escalated and had to be paid for in gold and only partly in silver.

By 1163, the English silver coinage was stabilized at a standard close to that of sterling silver, i.e. 92.5 per cent pure silver.

The silver pound sterling emerged in the 1100's and 1200's as a superior unit of account, evidenced by the penny of sterling silver, (92.5 per cent silver). The sterling silver penny coin had a strong reputation on the continent for consistent fineness and *sterling silver* became the silver of trade in a large part of the world. Thus the history of the pound currency began with the silver penny. The silver standard lasted in England until the 18th Century, when the growth of wealth and trade brought in large quantities of gold.

A modern avoirdupois pound of silver weighs 7,000 Troy grains, or about 14.583 Troy ounces of silver. At a modern price of say U.S. $6.00 a Troy ounce, the pre-medieval English silver pound would now be worth about U.S. $72.00. Today, the British paper pound "sterling" note is actually worth only around U.S. $1.15, (equivalent to about one sixtieth of the current value of the original silver pound). The base metal alloy 1-pound coin is replacing the pound note in circulation.

At least one could say in kindness that this decline did take over a thousand years, representing an average of up to a one per cent decline in "value" of the pound against silver every ten years or so.

Incidentally, the British government struck a 1983 silver one pound sterling (face value) collectors' coin, the first silver one pound sterling coin issued in Britain's history, although the Anglo-Saxon "pound" was, in fact, originally one pound weight of silver or about 12 Troy ounces.

The first coinage struck by Scotland was in 1124.

King Henry II's will, made in 1182, bequeathed

5,000 silver marks to the Templars
5,000 silver marks to the Hospitallers
5,000 silver marks to the common defence of the Holy Land.

Another 25,000 silver marks were left by him to various religious causes. He was the king who inadvertently ordered the murder of Thomas à Becket.

One should multiply those quantities of silver marks by about 60 to get an approximation in current U.S. dollars and by 80 to get Canadian dollars.

The silver/gold ratio in mediaeval England was about 11.1.

Henry also left legacies of 300 gold marks, (say currently U.S. $200,000) to poor Englishwomen of free condition as dowry to help them to marry.

The tunic that King Richard the Lionheart, son of Henry II, wore in Cyprus in 1191 is worth mentioning. His tunic was of rose-coloured samite and his mantle was spangled with small half-moons of solid silver set in rows, interspersed with shining orbs like suns. His golden-hilted sword was girt on with a silken belt and provided with a chased scabard of silver.

King Henry III introduced the hall-marking of silver and gold articles in 1238 and this system continues to this day and now includes platinum.

When Henry III issued his beautiful gold penny in 1257, the value ratio between silver and gold was set too low for gold and therefore the new coin was not popular and it was eventually dropped.

In England at the beginning of Edward I's reign, from 1272, export of coin and of precious metals was made more difficult, first by royal proclamation, then in 1299 by an Act of Parliament (27 ed. 1).

Edward III, 1327-77, issued striking new gold coinage.

Silver/Gold price ratio was 11:1 in England.

The word silver was first spelt that way in English in 1340.

The Black Death of 1348-49 wiped out almost half the population of Europe. This changed the course of European history.

Cardinal Beaufort, (died 1447), Bishop of Winchester, grandson of King Edward III and brother of Henry IV, certainly worked silver mines in Cornwall and Devon.

The "sovereign", introduced in 1489 by Henry VII, who had seized the throne four years before, was the first gold coin that was officially equal to a pound sterling in value. It weighed half an ounce, (compared to under a quarter of an ounce of gold contained nowadays in British gold sovereigns, which are still specially minted and are worth far more than their face value).

In 1497, (the year Cabot sailed from Bristol, England and discovered Newfoundland, now part of Canada), a Venetian diplomat wrote that England had already become the richest country in Europe and noted that "in one single street, the Strand, leading to St. Paul's, there are 52 goldsmiths shops, so rich and full of silver vessels, great and small, that in all the shops of Milan, Rome, Venice and Florence together, I do not think there would be found so many of the magnificence that is to be seen in London". That row of about as many silverware shops can still be seen but along Chancery Lane off the Strand, below street level, between Lincoln's Inn and the Royal Courts of Justice. It is an exciting place to visit.

Incidentally, King Henry VII Tudor gave 10 pounds sterling "to him that found that new isle", that is, Newfoundland. To get that in perspective, it was a relatively tiny sum, even for those days. He paid 13.3 pounds for a leopard, for example. Newfoundland soon became an important source of food (cod) for England. The English claim to Canada and North America was based on the discoveries of John and Sebastian Cabot. Sebastian organized the 1548 expedition to seek a northeast passage to India and was responsible for the naming of Argentina (Silver in Latin) from the silver he found there and its great river Plata (silver in Spanish).

The English silver shilling coin was first issued in 1504. Debasement of the coinage took place under Henry VIII, Edward VI and Mary who preceded Elizabeth I. The silver shilling was used in Britain's American colonies, (now the U.S.A. and Canada and the West Indies, Belize and British Guyana) from Elizabeth I onwards and in Australia, New Zealand, South Africa, East Africa etc.

During the Middle Ages, on the European Continent, extensive use was made of "billon", (there is no second "i"), for silver coinage, an alloy containing 20 per cent or less of silver. In England, the lowest coin alloy was 25 per cent silver in Edward VI's reign, 1547-1553.

Owing to production of silver in Germany and the dispersal of Henry VII's hoarded treasure by his son, Henry VIII, prices of foodstuffs rose 30 per cent, 1510-1540.

Owing to Henry VIII's debasement of the silver coinage and a little later on, with the silver flow from the Spanish-American mines beginning to take effect, prices of all kinds rushed up by 100 per cent or more, 1541-1561. Owing to Mary's better finance and Elizabeth's re-coinage, prices stabilized and rose more slowly, 1561-1582.

Elizabeth I, Queen from 1558, restored the standard to sterling, i.e. 925 parts of silver per thousand, which had once been and was to remain the standard for English coins for many centuries. The English gold standard for coins, eleven twelfths gold or 91.66 percent gold (= 22 carats fine) was adopted in 1526 and has not been changed since. She issued the first milled edge coins in 1562.

In 1560, Elizabeth called in by proclamation the existing currency of "silver" coins, (wantonly debased by her father), to be paid for in new silver money at a rate somewhat below their nominal value. Prices at large then steadied themselves.

Mining for silver and tin had been relatively backward in the British Isles up to the 16th Century, compared to the leading continental countries. The reign of Elizabeth marked a great expansion of mining of all sorts, lead from the Mendip Hills of Somerset for export through Bristol, copper etc. from the Lake District, tin from the mines of Cornwall and English iron (which was then regarded as the best in the world).

The debased coinage which Elizabeth I recalled from circulation must have been highly adulterated for not only was the dross worthless enough to be used as road filling, but many workmen died from the fumes emitted from remelting. This re-establishment of Mint coinage was unpopular. It left no minor medium of exchange except private merchants' takens of lead, tin or copper. However, low denomination Irish coins of brass and copper had been made as early as 1461, but not until 1630 were small English coins all made of copper.

In 1577, a parson recorded that, during his lifetime, there was a change from "treen (wooden) platters into pewter (a tin alloy) and of wooden spoons into silver or tin". Forks were unknown then. The influx of silver captured from the Spanish fleets by early freebooters (such as Drake, Hawkins, Gilbert, Frobisher etc. later on) may have been a contributing factor.

Incidentally, populations of some cities in 1575 were

1)	Paris, about	300,000
2)	London, about	180,000
3)	Cologne (Köln) about	35,000

Populations of European countries in 1600 were approximately

1)	France	16 million
2)	Germany	14.5 million
3)	Poland	11 million
4)	Spain	8 million
5)	England and Ireland	5.5 million
6)	England	4 million
7)	Holland	3 million

World population in 1650 has been estimated at 500 million.

IT IS INTERESTING TO NOTE THAT MANY HUNDREDS OF MILLIONS OF PEOPLE OUTSIDE EUROPE NOW SPEAK ENGLISH OR SPANISH, ALTHOUGH BRITAIN AND SPAIN, IN THE CRITICAL 1500-1600 A.D. PERIOD, WERE NUMERICALLY VERY INFERIOR TO FRANCE AND GERMANY. Most people in Ireland then spoke Gaelic, not English.

A few million outside Europe in Quebec, Africa etc. now speak some French, but virtually none speak German.

English and Spanish are certainly the working languages of the main silver-mining countries, Peru, Mexico, Canada, U.S.A., Australia, South Africa and Chile, except for the Slavic language countries of U.S.S.R. and Poland.

The gradual but constant rise of prices, largely due to the flow of *silver* from the Spanish-American mines, made it impossible for James I and Charles I, 1603 to 1649, to "live on their own revenues".

American mine supplies of silver again forced up prices in the 1643-1652 period of Charles I and Cromwell.

In 1650, the world produced about 44 times as much silver as gold.

In 1662, the last silver pennies were minted in London. A new gold coin was minted during the reign of Charles II in England, 1660-1685, called a "guinea", because the gold came from Guinea in West Africa, (1662).

In 1664, British Colonel Nicolls and 300 men seized New Amsterdam, (renamed New York because the territory was given to James, Duke of York, later James II).

By 1690, there were 10,000 settlers in Canada.

The British silver coinage was rehabilitated in William III's reign.

In 1699, the London Chamber of Commerce described silver money "as more useful and of more employ than gold".

The second largest city in England, Bristol and the third largest, Norwich had only about 30,000 people each in 1700.

Until about 1700, the air in Europe did not tarnish silver. It is the sulphur compounds that tarnish silver and such chemicals in the air began to multiply after 1700. London had 750,000, Amsterdam 600,000 and Paris 500,000.

Sir Isaac Newton set the price of 22-carat gold at 3 pounds, seventeen shillings and tenpence halfpenny per Troy ounce in 1717 and this price lasted about 200 years, in the U.K., the British American colonies, the U.S.A., Canada etc. This naturally had a noticeable effect on the silver price.

TRIAL OF THE PYX

From the 13th century about 1238 A.D. and probably earlier there was a regular procedure for verifying the alloy composition of newly minted English coins, called the Trial of the Pyx and conducted by a select group from the Worshipful Company of Goldsmiths.

The pyx was the box in which the coins selected for testing were stored in a side chapel of Westminster Abbey.

The Trial was important in establishing credibility and trust in the purity of the English coinage. However, the Royal Mint was quite a primitive operation even as late as 1700. Coin size was difficult to control. Abuse of the currency, by a section of the public, particularly of silver coins, was common. Such bad (counterfeit) silver coins drove the good coins out of circulation. See Hallmarks.

England had to spend about 30 million pounds between 1733 and 1766 on silver bullion to cover its purchases of spices, silk etc. in India and the Far East. Asia wanted silver, not European goods such as woollens.

In 1779, four Royal Navy frigate captains were awarded the staggering prize money of 40,000 pounds sterling each for capturing two Spanish ships laden with silver. Their regular pay was less than 200 pounds a year.

Silver (and gold) in ore in the ground in the U.K. automatically belongs to the Crown, i.e. the government, to this day.

Germany

We do not know the full story of supply and demand for silver and gold in Continental Europe during the Middle Ages, but we know enough for our present purposes.

There is little to be said about the period from the end of the Western Roman Empire to the early Middle Ages. The monetary problems of the area comprising what was originally the Western Roman Empire actually began under late Roman rule. It was continued much later under the Germanic Salian Frank, Childeric I, father of Clovis, (Chlodwig, Ludwig), who became the first Frankish ruler of Gaul, i.e. France, from 486 A.D.

Money began to depreciate after the great Germanic invasions. These new ethnic monarchies ruling in the West made no innovations and retained the gold Byzantine solidus coin.

With the collapse of the Western Roman Empire and its economic and cultural level resulting from the Germanic takeover of Gaul and Spain there was little demand for gold coins. 300 years later, the Frankish King-Emperor Karl der Grosse, (Charles the Great, Carolus Magnus, Charlemagne), 742-814 A.D., abandoned the gold standard and in 780 A.D. replaced it with a compulsory monetary system based on the denarius or successful English silver penny, which became the only important coin on the European continent.

The numerary pound, (pfund, librum, livre), or legal tender, in the time of Charlemagne, comprised 20 solidi or shillings each containing 12 pennies of silver. Its multiples, the pound, (pfund, libra, livre), equalling 12 pennies were moneys of account, but he issued silver coins of 1 denarius, (denier or penny). This accounting system of pounds, shillings and pence, (pennies), in those same proportions, were retained for 1,200 years by England, still written as L.s.d. (libra; shillings or solidi; denarii) until 1970, when decimalization of the U.K. and the Irish coinage was finalized.

The Charlemagne pound represented a weight of 267 to 492 g. However, it is known from a letter of Pope St. Gregory, that the earlier gold solidus coins minted by the Franks were not accepted in Italy. At an early date, coining escaped from the control of the public authorities and became private and this, together with the privilege of immunity which the early Frankish kings handed out indiscriminately, led to a proliferation of mints which became increasingly fraudulent.

For several centuries, the silver denarius or penny was the only currency — the only coin in circulation. They lasted until the revival of international trade, several centuries later, around 1200, brought a resumption of demand for gold coins in Western Europe.

The minting of silver money was made possible by intensive exploitation of the Hartz and Bohemian mines, and of a mine in Poitou at Melle, a name derived from the Latin word metalla, meaning "mines".

Mining of silver by Germans began in 745 A.D. at Schemnitz, (when Charlemagne was a baby), in 928 at Rammelsberg, in 970 at Goslar in the Harz mountains and at Freiburg in Saxony in 1170. Silver-bearing lead is still mined at Freiburg and Johanngeorgenstadt.

Silver mines were worked in the 9th century A.D. when new German silver mines opened in Alsace, the Black Forest and the Harz mountains in the 10th.

In the mid-12th century, the discovery of silver at Freiburg was even more important than the earlier finds. Between 1100 and 1300, new gold and silver mines opened in Bohemia, Transylvania, and the Carpathians. The ore in the Erzgebirge (ore mountains) was so rich in silver that, by 1474, there were as many as 176 mines being operated in the Schneeberg/Annaberg district (now in East Germany). From the 9th century on, the increase had been slow at first but later on become more rapid within the overall quantity of precious metal available in Europe.

Around 1300, the largest silver mine output was at Joachimsthal, Bohemia, now northwest Czechoslovakia.

Trade had revived in the 1000's and 1100's and there arose a need for heavier silver coins than the pennies that had depreciated. These new coins were called groats, from the Dutch for big, "groot" and appeared from about 1200 A.D. In the 13th century, France began the issue of improved silver coins, "gros parisis". A series of new gold coinages also resulted, commencing in 1231 in Germany and Italy.

The large, heavy silver Joachimsthaler coin, (shortened to thaler in German, daalder in Dutch and "dollar" in English), was first coined in 1519 A.D. in Bohemia, by the Count of Schlick, the owner of the silver mines which were discovered in 1516 in the valley ("thal" in German) of St. Joachim. It was intended to be the silver equivalent of the gold gulden, a coin current in Germany from the 14th century. It contained about 0.8 Troy ounce of silver. It was later adopted by Austria as the "thaler" of the same weight of silver and in turn by Spain as the "8-reale" silver coin, known to Americans as "8 bits" and to the English as "pieces of eight", again with the same amount of silver.

This, in turn, led to the U.S. silver dollar, which had 0.77 troy ounce of silver.

From the ninth to the mid-thirteenth century, gold was so scarce that, with few exceptions, no gold coins were minted in Western Europe. Gold bezants from Constantinople circulated all over the continent. Silver was coined in most countries, the standard being derived from the silver penny, (deniers, denarii, pfennige). However, a shortage of silver had led to the alloying of more and more copper, until by the mid-13th century, most of these "silver" coins were black.

During the early Middle Ages, the Byzantine and Arab gold coinage was far more important to Western Europe than any of the small gold mintings in Europe itself. England's early medieval government accounts were kept partly in bezants.

The Byzantine or Eastern Roman Empire based on Constantinople had retained the Roman gold coin, known to us as the bezant. The Arabic dinar was an imitation of certain Roman coins. The bezant kept its weight and fineness, or purity, for well over 600 years, from 575 A.D. to the early 1200's.

In fact, its common name in the Eastern Empire became "perper", from the Greek word hyperperon, "most pure". The earliest Greek coins had, in fact, consisted of very pure gold or silver, i.e. 990 to 997 fine, or 990 to 997 parts in 1,000.

Between 1300 and 1450, availability of gold and silver in Europe was declining because of more bullion flowing eastwards to pay for spices etc. and because demand for use in coin, plate and jewellery in Europe itself was rising. Between 1450 and 1520, there was some relief through discovery of new mines, mainly of silver, at Schwatz, Schneeberg, Annaberg and Joachimsthal. Then the large flow of silver from America to Spain began.

In the early 16th century, German mine production of silver was over 13 metric tons a year.

Over the long term, the value of silver, (in relation to gold), had increased from the 13th to the 16th century, up to about 1550. Gold was relatively plentiful then and so the owners of silver mines, mainly in Germany, and holders of silver bullion became much richer.

State supervision of mines came in Saxony in 1554.

Two of the wealthiest medieval families in Germany were the Welsers, (who once owned Venezuela), and the even richer family of Jakob Fugger, "Fugger the Rich", around 1420-1560. The Fuggers had started as peasant weavers and expanded into silver, copper and mercury mining. The latter had a virtual monopoly on European silver and copper mining. Fugger success and wealth grew from knowledge of Europe's markets — the demand for silver in Antwerp, for copper in Danzig etc. This powerful family would routinely lend large sums of money to Hapsburg kings, such as Maximilian I. The family's palace was in Augsburg in Southern Germany. Incidentally, it was to this palace, built largely on the profits from silver mines in the Tyrol and copper mines in Hungary, that Martin Luther was summoned by the papal legate in 1518 to revoke his 95 theses. The fortune of the Fuggers was estimated at 4 million guldens (gold coins) in 1546.

Fugger and his family later acquired silver mines in Guadalcanal, Spain and mercury mines at Almaden in the same country and in 1534 acquired the right to coin money.

The medieval German silver "dollar" coin, originally Joachims-thaler, daler or thaler, has given its name to the modern dollar currencies of the U.S.A., Canada, Australia, Hong Kong, Singapore etc. That's not a bad record for the influence of silver on money.

Silver guilder coins were introduced in Germany in 1500. The guilder remains the currency of Holland to this day. In Austria, the guilder remained in use until 1892.

Silver bromides were discovered by Schultze in Germany in 1727.

Austria and Hungary

In the 1500's, Austria and Hungary produced about 50 per cent of Europe's silver.

When Bohemia was absorbed into the Austrian Empire, the Joachimstaler silver thalers (or dollars), (see Germany), were continued and they became the chief money of the vast Empire, which later included Spain and its possessions in America.

The most famous silver coin of our present millenium is the 1780 "thaler" (dollar) of the Austrian Empress Maria Theresa.

It has been minted continuously ever since, (with that same original date), because it is still, to this day, the only "money" that great numbers of people in the Middle East will trust, as distinct from the paper money that loses its value so fast. This is in spite of the fact that Austria never had any territorial possessions there.

The original Maria Theresa Thaler (dollar) measures 42.5 mm in diameter and is 83.33 per cent silver. It has enjoyed global popularity because of its attractive design and consistent silver content. This coin was later struck in Mints in Prague, Milan, Florence, Venice, Rome, Leningrad, London, Paris, Brussels, Bombay and other mints, (with the same original date on them), because it had gained acceptance in trade. And, even to this day, the Maria Theresa Thaler circulates in the Middle East and Africa as an accepted and well trusted currency.

The Maria Theresa Thaler was not the first coin to be called a "thaler". In the early 15th century, the rulers of Bohemia minted the coin called the Joachimsthaler because the most prolific silver mines in Europe were then in Joachimsthal, Bohemia. It contained eight-tenths of an ounce of silver, as did the "thalers", sometimes called "talers" or "dalers", issued during the following centuries. The American colonies were familiar with the "thaler" and its silver content and when most of the British colonies achieved independence from England, Alexander Hamilton proposed that the currency of the United States be called the dollar — an obvious corruption of the word "thaler".

France and Canada

The first francs were coined in France in 1360.

Jacques Cartier the Breton first referred to silver in Canada after his second voyage of 1534-36 and this was probably native (naturally occurring) silver from what is now Cobalt, Ontario.

In 1613 and 1615, sixteen years after Cabot discovered Newfoundland, Champlain pushed up the Ottawa river and discovered what is now silver-rich Ontario, reaching the eastern shore of Lake Huron, the first European to tell of the vast Great Lakes. He mentioned silver in 1613 at St. Mary's Bay, Nova Scotia. Some Indians had silver artifacts. He founded Quebec city in 1608. French Canada had been much extended during the reign of Henry IV, 1589-1610.

By 1700, French Canada had an estimated 6,200 people compared to British New England 130,000, Virginia-Maryland 87,000 and New York, New Jersey, Pennsylvania and Delaware 65,000.

Italy

In Italy, silver deposits were worked in Tuscany and in Sardinia from Etruscan times — long before the Romans. Tuscany is a corruption of Etruscan. The Etruscan heartland was in the triangle formed by the Arno and Tiber rivers and the west central Italian coast. Metal mining was the creator of the Etruscan city-states.

The first *silver* "florin" coins were minted at Florence, (hence their name), Italy, in 1189. Gold Florins were minted in Florence in 1252. The Crusader force of 1204 led by Venetians sacked Christian Constantinople and the silver and gold brought back made it possible to mint gold coins again in Europe after many centuries. Gold's return helped to stimulate the Renaissance.

In the time of the Medicis in Renaissance Florence, gold was used for wholesale prices and silver for retail prices.

Spain and The Americas

From 1500 A.D. the increasing amounts of silver looted and mined by the Spanish in the newly discovered Americas greatly added to the total supply in Europe.

Pizarro took 134,000 pounds of silver from Peru and Cortes took 759 pounds of silver out of Mexico. By 1545, the Spanish had discovered the very important silver mines at Potosi, now Bolivia, (then Upper Peru) and at Zacatecas, Mexico.

For the total period 1521 and 1660, silver imports into Europe were about 18,600 tons of fine silver. (This would have made approximately 700 million American silver dollar coins). This silver influx financed the Hapsburgs. Over the same period, gold imports from the Indies to Europe amounted to approximately 181.333 metric tons.

Consequences of Spanish silver imports from America into Europe were:

1) latent inflation
2) price rises
3) marketing crises
4) bankruptcies of governments (decline of the Fuggers).

Gold and silver coins recovered in recent years from Spanish treasure galleon wrecks look almost new in spite of some 300 years in salt water.

In 1493, the stock of silver and gold in Europe has been estimated at 33.4 million pounds sterling (in 1954 pounds), J.F.C. Fuller.

The total amount of stock of gold and silver in Europe in 1500 has also been estimated at somewhere near $300 million in 1940 dollars.

In the year 1500, before the arrival of significant amounts of metals from the Americas, there were possibly 20,000 tons of silver in Europe on surface in metal form and maybe 2,000 tons of gold.

Allowing for losses, the stock of precious metals in Europe increased about seven times between 1500 and about 1650. Between 1500 and 1650, fleets from the Indies unloaded 16,000 tons of silver at the ports of Seville and Cadiz, Spain, (official figures).

The large amounts of silver imported from America into Spain did not stay there but flowed north to England, France, the Netherlands, Germany and North Italy, in part to pay for the Baltic grain now needed by certain Mediterranean countries such as Spain which were no longer able to feed themselves.

From 1536 to 1636, over 250 million pounds sterling (1954) of silver and gold entered Europe, according to Trevor Davies. The silver and gold bullion flowed into the hands of the money-lenders of Genoa, Antwerp and Augsburg. Silver and gold spent in Holland financed the Baltic States and became the magnetic centre of the reformed religion. Holland had revolted against Spain in 1567.

Between 1500 and 1680 this flow of silver from the Americas resulted in a great surplus and therefore gold became scarce. Important quantities of silver and gold were taken forcibly as loot from the Spanish fleets by English pirates/privateers such as Drake, as well as some taken by French and Dutch freebooters. Dutch piracy against the Spanish silver fleets started about 1609.

The marriage of one of the Austrian Hapsburgs to a Spanish princess in 1496 led to the production of what we call silver "pieces of eight" (or, later, "dollars").

When the great Queen Isabella and King Ferdinand of Spain had died by 1516, the Hapsburg, later Austrian Emperor Charles V, was offered the Spanish throne, accepted and became King of Spain in 1518 as Charles I.

Charles V controlled European *silver*, lead and copper production and he had a monopoly of mercury output.

The basic Spanish coin then was the silver real ("ray-al") containing about one-tenth of a troy ounce of silver. The Austrian thaler (adopted from the large Bohemian Joachimsthaler silver coin) contained eight-tenths of a troy ounce of silver.

To lubricate trade between the two parts of the Hapsburg Empire, Spain and Austria, the Spanish produced an 8-real (8-reales) silver coin equivalent in silver and value to the Austrian thaler, (dollar). The Spanish 8-real silver coin was produced in extremely large quantities over several centuries from Mexican and Peruvian silver and circulated widely, including unfettered circulation in the English colonies in North America.

The English-speaking settlers called them "pieces of 8" or dollars (thalers). The word dollar (daler, daleir, dallor, dolor) has been used in English since 1553. A Spanish or Austrian silver dollar was worth 5 English shillings in 1560 and eight shillings in paper money of New York in 1767.

These "Spanish" silver dollars were, believe it or not, still legal tender in the United States until as late as 1857. It is interesting to note that Canada issued its first silver decimal coins, modelled on the U.S. pieces, in 1858.

The Austrian silver thaler (dollar) is still minted in quantity in Austria, (with Maria Theresa's head and the original date, 1780), for use in the Middle East where it is the money that is most trusted by very large numbers of people.

> " 'Tis not all gold that glisters and every man was not born with a silver spoon in his mouth."
>
> —Miguel de Cervantes Saavedra,
> 1547-1616, Don Quixote, II.IV.73

(In the days when babies teethed with spoons, only the babies of wealthy families would have silver spoons in their mouths.)

Incidentally, spoons (of silver presumably) were mentioned as early as 1,000 B.C., 2 Chronicles, 5.

U.S.A.

Between 1774 and 1783, there were a number of private coinage projects in the U.S., some permitted by the individual States. One is a large silver coin based on the Spanish "real" or dollar, inscribed "Continental Currency 1776" which closely resembles the later U.S. standard silver dollar coin.

IMPROVEMENTS IN MINES

It was for silver that mining progress (galleries, pumping out of water, ventilation) was accomplished, (in medieval Germany), according to Fernand Braudel, the eminent French historian and author.

A wealth of ingenuity was expended in the quest for silver.

The double smelting of copper by the lead process made it possible to separate out the silver in its ore as early as the fifteenth century.

IMPROVEMENTS IN TECHNIQUES IN THE USE OF METALS AND ALLOYS

What stimulated the development of improved silver and other metals fabricating techniques? Well, it was usually in the decorative arts that new methods for working with precious and other metals were first developed.

NAMES OF MODERN CURRENCIES

Silver became money in some cases, even without gold. The Roman silver denarius coin, which was legal tender from about 2,200 years ago, still gives its name to the modern "dinar" currencies of Muslim countries such as Algeria, Tunisia, Libya, Jordan, Iraq, Kuwait and Bahrain as well as Yugoslavia in Europe, which has an important Muslim minority. The legal tender of fabulously wealthy Saudi Arabia, the silver riyal, is the same weight and fineness as the old Indian silver rupee, which was long Saudi Arabia's principal commercial connection. For a long period of time, the Maria Theresa silver dollar has been accepted and desired as money since 1780 in Arabia and the Middle Eastern countries, and is still preferred over paper money by very large numbers of prosperous people there.

EUROPEAN ORIGINS OF THE NAMES OF COINS OF THE ARAB WORLD IN GOLD AND SILVER

French	**English**	**Greek**	**Latin or Italian**	**Arab States**	**Egypt, and certain Arab States**
	guinea (gold coin, was valued officially at 21 English shillings). (the guinea is now only a snob expression in the U.K.)				**Egypt** ginay (ah), *official* name for the Egyptian pound)
	shilling. (1/20th of an English pound) (The shilling unit, dating from 1,200 years before, was discontinued in the U.K. in 1970).				"shillin". (popular name for 5-piastre coin which is 1/20th of one pound)
"half-franc"					1-piastre coin, popularity called "nuss frank" (1/2 franc).
Napoleon coin					"Na*b*oleon", (for gold coins of a certain size.)

EUROPEAN ORIGINS OF THE NAMES OF COINS OF THE ARAB WORLD IN GOLD AND SILVER (Continued)

French	English	Greek	Latin or Italian	Arab States	Egypt, and certain Arab States
		drachma (silver) was the currency of early Greece.		dirhem or dirhan	**Egypt** Arab silver dirhems were popular with the Vikings for their silver content — not as currency, a concept that was foreign to them.
			denarius (or denier), originally a Roman silver coin. The 'd' was used in the British world as the abbreviation for the English penny for about 1,200 years until 1970.	dinar (name of the currency in 9 Muslim countries)	
			lira. Italian for Latin librum, (pound weight) from which derives the 'L' (crossed, twice horizontally), (L) which is still the modern abbreviation for the English pound which was originally one pound weight of silver.)		**Egypt, Syria** and certain other Arab countries. (sometimes used for the pound) "lira"

Chapter 3

Price of Silver

The U.S. dollar lost more than half its value in the period 1971 through 1982, while silver and gold now have a value five to eight times higher than in 1971.

The Canadian dollar fared even worse than the U.S. currency vis-a-vis silver and gold prices in that 12-year period.

3.1 THE PERMANENT VALUE OF SILVER AND THE PRICE — THE UNDIMINISHED PURCHASING POWER OF SILVER AND GOLD

"Silver is money you can trust." So is gold.

Over time, silver and gold have retained their purchasing power.

You could, in the U.S.A., about twelve years ago, buy a U.S. gallon of gasoline for a pre-1965 U.S. silver quarter, (25 cent piece). (A U.S. silver dime of pre-1965 contains about 7/100ths of a troy ounce of silver and is now worth over 40 cents U.S.)

Early in 1984 YOU COULD STILL BUY that gallon — if you had the modern purchasing power of the silver content of a 1965 (or earlier) U.S. silver quarter, which is 90 percent silver, (and *today you will get change as well,* but in low intrinsic value copper-nickel or copper-zinc coins, of course, *not* silver ones).

The Canadian silver quarter of twenty years ago was only 80 per cent silver. It is now worth about C.$1.48. Four 25-cent silver pieces (which then made up 1 nominal dollar) are now worth about C.$5.92.

About 580 A.D., in Frankish Gaul (France) under King Guntram, in conditions of extreme famine, one third of a gold coin would buy a bushel of wheat, which would cost about U.S.$4 in modern terms. Nowadays, that weight of gold would buy at least four bushels. In Gaul in those days, things were so bad that the poor sold themselves or their children into slavery in order to obtain something to eat.

It took no more gold by weight to buy a clay brick or a loaf of bread in 1960 than it did in 1560, as shown in the researches of Professor Jastram of Berkeley, CA.

In 1621 A.D. it took 0.012 ounces of gold to buy a bushel of wheat. Today, 364 years later, it takes about 0.011 ounce of gold to buy a bushel of wheat.

200 years ago, 1 troy ounce of gold or 16 ounces of silver would purchase a suit of clothes. *IT STILL DOES.* Actually, a U.S.$20 gold piece (coin) would get you a good suit of clothes in 1930, but a U.S.$20 gold piece today will, in fact, buy you TWO SUITS of the best quality.

Put another way, an ounce of gold or silver now purchases at least as much retail merchandise as it would have purchased 200 years ago. No circulating paper money can say that.

In the early 1930's, 200 ounces of gold, or 9,900 ounces of silver, could buy a house in most areas. *IT STILL COULD IN MID-1984.*

Twenty years ago, in 1965, 31.1 g. (1 Troy ounce) of gold would buy 11.5 hours of mine labour in North America. In late 1984, it bought 33 hours.

In 1965, 1 Troy ounce of gold would buy 100 pounds avoirdupois of copper, but late in 1984, it would buy six times that amount of copper.

In 1965, it took 809 g. (over 25 Troy ounces) of gold to buy the Dow Jones Industrial Average. Late in 1984, it took only about one-tenth of that, 85 g.

Only 14 years ago or so, when mortgages were 5 per cent and gold was $35 an ounce, most of the media and many public commentators poured scorn and derision on those writers who predicted $200 gold and 10 percent mortgages. Currently, gold is worth about nine times the price of only 14 years ago, i.e. it is now around U.S.$300 an ounce. Silver is similarly strong.

Who is smiling now? Those who bought silver and gold coins and bars and saved them.

The price of silver in constant dollars, (i.e. adjusted for inflation), climbed from 25 U.S. cents an ounce in 1930 to $7.00 in 1982, 28 times higher. That is, $7 or so now buys you only one ounce of silver, whereas in 1930 it bought you 28 ounces.

The silver price is now double to triple what it was in the 1970's.

The average price of silver in the U.S. was $10.52 in 1981, $7.95 in 1982, $11.45 in 1983 and $8.1495 in 1984.

However, it is still, fortunately, by far the cheapest of the precious metals and should remain so. It is, in the words of Paul Sarnoff, in 1984, "ridiculously cheap".

In many parts of the world today, paper money is still not trusted — only silver coins such as the Austrian Empress Maria Theresa dollar are — and who can blame them?

The Maria Theresa silver dollar of the 18th Century is still being minted in considerable volume in Vienna, Austria, every year — with the original 1780 date on it — in order to keep up with the continuing formidable demand for them. They are trusted as the "real" money, (as British gold sovereigns are), particularly in the Middle East and East Africa, as distinct from the questionable paper money of over 60 countries in Africa and the Near East. During the German occupation of Austria, 1938 to 1945, Britain minted vast numbers of Maria Theresa silver dollars, (with the full silver content and the original date on them, 1780), in London for war use in the Middle East as the money that most people there trusted, rather than unacceptable paper pound notes and other paper currencies BECAUSE SILVER DOES NOT LOSE ITS VALUE. The bulk of this silver was from the U.S. Treasury, on loan, i.e. war-time "lend-lease", and was returned to the U.S. after the war.

Paper money example: In the 1950's, the equivalent of 5,000 modern Israeli shekels would buy 3 homes. In early November, 1984, the 5,000 shekel note was worth only $8. The mighty pound sterling note, worth U.S.$5.00 some years ago, had fallen to only U.S.$1.10 by January 14, 1985, (about $1.48 Canadian).

A Brazilian, Mexican or Argentinian resident holding silver and/or gold in the last 12 months has been very happy indeed, looking at their paper money's massive decline in purchasing power in that year. Silver and gold have not lost their value.

A bag of 1904 New Orleans U.S. silver dollars sold for $8,500 in 1978, but today that bag would be worth $58,000.

During the Great Depression in the Western world in the 1930's, (before massive subsidies were paid out to U.S. farmers — $19 billion in 1983), prices of food then, taking the U.S. as an example, were typically:

Bread	10¢ for a small loaf
Milk	10¢ a quart
Eggs	25¢ a dozen
Butter	25¢ a pound

In 1980, the comparable prices up to 50 years later were only about 4 to 8 times as high.

Bread	43¢
Milk	52¢ (1 quart fresh for 24 cents in 1965)
Eggs	95¢ (1 dozen for 56 cents in 1965)
Butter	1.90¢ (1 lb. for 76 cents in 1965)

However, in 1935 a medium-high paid white collar worker earned only U.S.$1,200 to $1,500 a year, whereas in 1980 such a worker earned $16,000 to $20,000, or apparently around 13 TIMES AS MUCH, but, of course, he now pays out a much higher proportion of his income in taxes and when he spends his money, a sizeable further amount goes in sales taxes, fuel taxes etc. One must also mention that $1,200 or $1,500 in 1935 would be worth a great deal more in numbers in the paper dollars of 1985.

Further, because of technology, everyone nowadays has possessions worth 30 to 100 times as much as his counterpart had then, in North America at least.

The recent Dow Jones Industrial Average has been around 1200. If that is adjusted on a basis of real or constant 1940 dollars, it is only 120. It is therefore clear that stocks and shares have not, generally speaking, protected investors from inflation in the last 45 years. It might be considered worthwhile to read the first few paragraphs of this chapter again.

Inflation is a depreciation — substantial and persistent — in the purchasing power of the monetary unit, e.g. the dollar. The falling power of the dollar domestically is seen in higher prices for many things. It is a silent added tax. In response, people frequently save less and buy more in anticipation of further price rises and some buy silver and gold in those situations as the better hedge.

If it ever became true that inflation could be stopped permanently, the price of gold would plunge, as the major reason for owning it would have disappeared. In point of fact, it is virtually impossible for central *governments to stop inflating* or even significantly reduce inflation for very long.

GROWTH IN CONSUMER PRICES (U.S.$)

	1969	**1979**	**1989 Projected**	**Projected Increase over 1969**
Quart of milk	31¢	51¢	93¢	3 times
Loaf of white bread	23¢	42¢	84¢	3.6 times
Pound of coffee	76¢	$3.27	$14.07	18.5 times
Chocolate bar	5¢	25¢	70¢	14 times
Chewing gum	5¢	20¢	80¢	16 times
Hospital room for one day	$46.10	$131.38	$374.43*	8.1 times
Apples per pound	15¢	44¢	$1.02	6.8 times
Postage stamp, U.S. first class	6¢	15¢	34¢	5.6 times
Newspaper	10¢	20¢	48¢	4.8 times
Paperback novel	$1.25	$2.60	$4.88	3.9 times
Toilet paper	15¢	20¢	27¢	1.8 times
Tube of toothpaste	95¢	$1.45	$2.21	2.3 times

n.b. In the 10 years between 1969 and 1979, consumer prices — overall — rose 95 per cent.

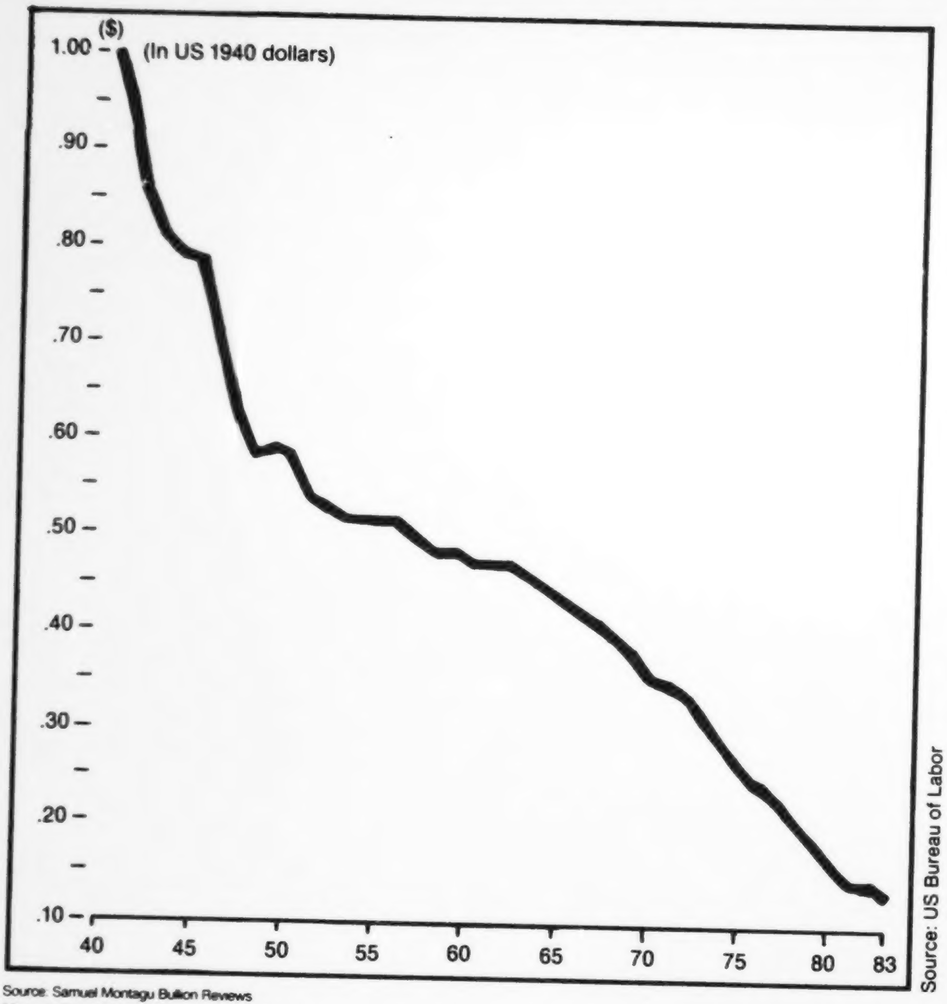
Some will say that certain of the projected 1989 figures are here already, (particularly when one is shopping in Canadian dollars).

(The Canadian dollar was last at par with the U.S. dollar in November, 1976.)

*This projection may already be too low. A late 1984 charge for room and board only at a U.S. teaching hospital on the East Coast was U.S. $398.00 a night, for example.

Will the value of silver and of gold rise along with the above scenario, or rise at an even greater rate?

THE VALUE OF THE DOLLAR OVER 43 YEARS



Source: US Bureau of Labor

Source: Samuel Montagu Bullion Reviews
Moscow Norodny Bank Reviews; Hardy & Harman

The value of the paper dollar has dropped steadily, according to official U.S. statistics. Dismal records like this of paper currencies is why people buy silver for insurance.

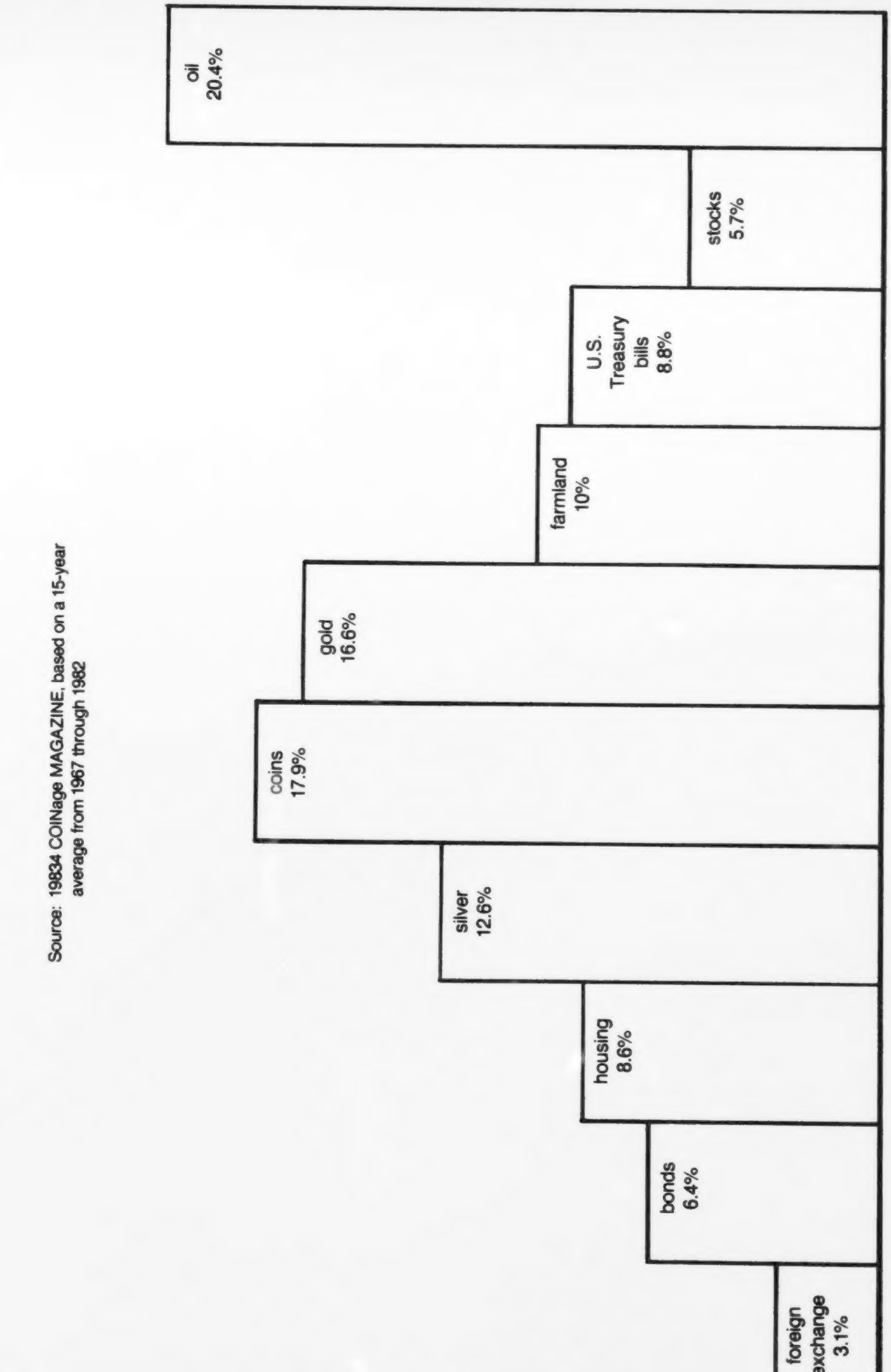
Silver coins of 1940 through 1964 have, in contrast, increased their value enormously over the years. The pre-1965 dime or 10-cent piece is now worth U.S. 50 cents. The dollar (in dimes) of pre-1965 is now worth U.S. $5.00.

Source: Silver and Gold Report

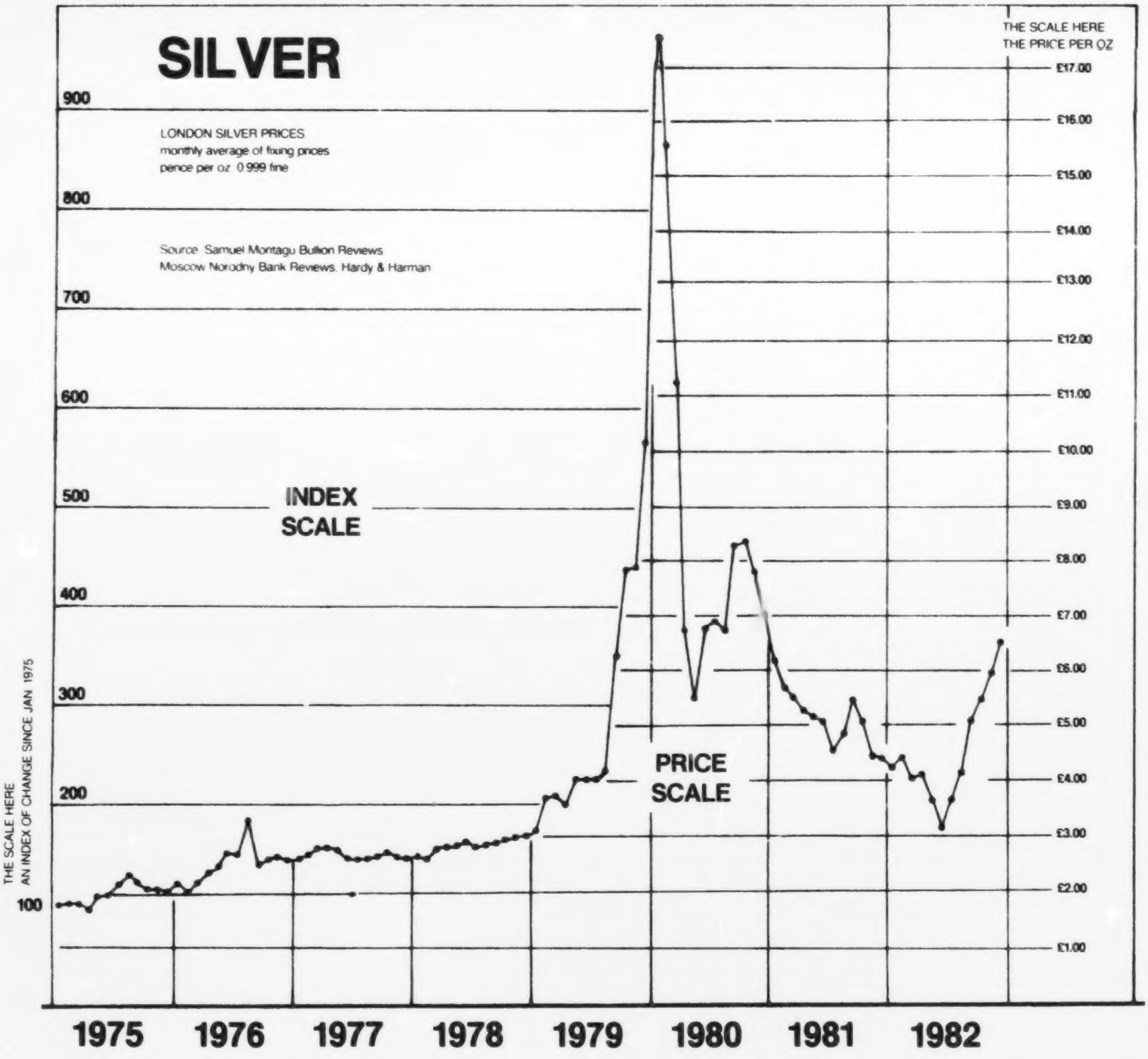
Silver's long history shows that it gains value in periods of social unrest, of wars and of inflation. Not only does it consistently gain value but it holds on to its value or purchasing power over the long haul. Certainly, this has been dramatically shown once again, particularly during the history of the last seventeen years.

The Commodity Research Bureau index of futures prices in the U.S. for imported materials, (coffee, sugar, cocoa etc.), normally closely parallels that for precious metals prices. The former started to turn sharply upwards from December 27, 1984.

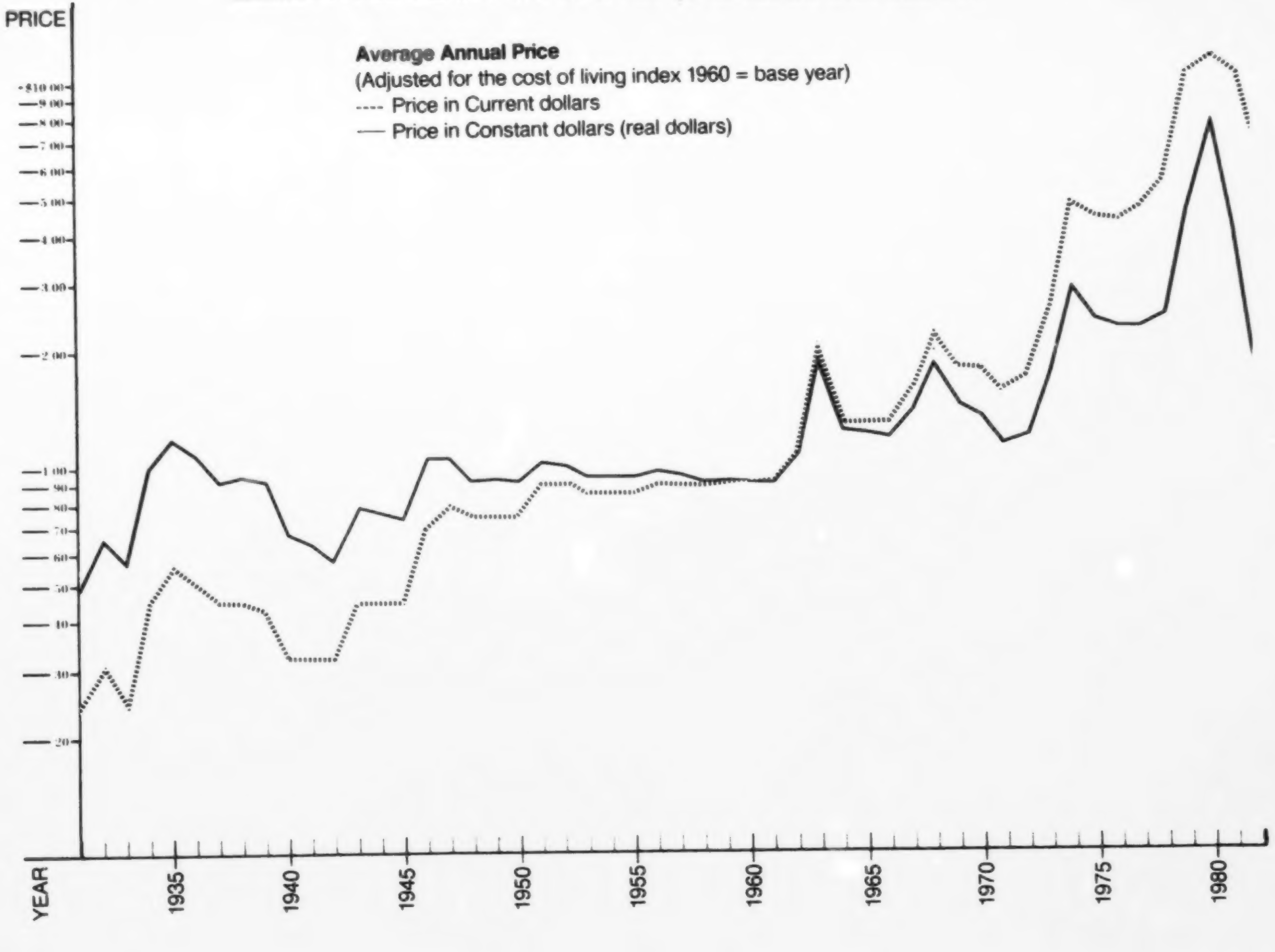
AVERAGE ANNUAL RATE OF RETURN ON INVESTMENT



Source: 19834 COINage MAGAZINE, based on a 15-year average from 1967 through 1982


SILVER
LONDON SILVER PRICES
monthly average of fixing prices
pence per oz 0.999 fine
Source: Samuel Montagu Bullion Reviews
Moscow Norodny Bank Reviews, Hardy & Harman
INDEX SCALE
PRICE SCALE
THE SCALE HERE AN INDEX OF CHANGE SINCE JAN 1975
100
200
300
400
500
600
700
800
900
THE SCALE HERE THE PRICE PER OZ
£17.00
£16.00
£15.00
£14.00
£13.00
£12.00
£11.00
£10.00
£9.00
£8.00
£7.00
£6.00
£5.00
£4.00
£3.00
£2.00
£1.00
1975
1976
1977
1978
1979
1980
1981
1982

SILVER: A 50 YEAR PRICE CHART *(in constant U.S. dollars)*



Source: Scott Dial; Silver and Gold Report
The 1984 average silver price was U.S.$8.1495 an ounce, Comex 1st. position and U.S.$8.1185 equivalent, London Metal Exchange cash.

CONSTANT DOLLAR OR REAL PRICE OF SILVER

Year	E52 WPI (Warren and Pearson)	Average Price — Silver, New York, Current U.S. cents	Constant Price, U.S. cents per ounce — Silver 1967 = 100
1868	55.7		
1869	53.2	132.50	241.06
1870	47.6	132.80	278.99
1	45.8	132.50	289.30
2	47.9	132.20	275.99
3	46.9	129.70	276.55
4	44.4	127.80	287.83
5	41.6	124.00	298.08
6	38.8	116.00	298.97
7	37.4	120.00	320.86
8	32.1	115.00	358.26
9	31.7	112.00	353.31
1880	35.2	115.00	326.70
1	36.3	113.00	311.29
2	38.1	114.00	299.21
3	35.6	111.00	311.80
4	32.8	111.30	339.33
5	30.00	106.50	355.00
6	28.9	99.50	344.29
7	30.9	97.80	315.50
8	30.3	94.00	310.23
9	26.6	93.60	351.88
	E-23 WPI		
1890	28.9	104.60	361.94
1	28.8	98.80	343.06
2	26.9	87.60	325.65
3	27.5	78.20	284.36
4	24.7	63.00	255.06
5	25.2	65.28	259.05
6	23.9	67.06	280.59
7	24.0	59.79	249.13
8	25.0	58.26	233.04
9	26.9	59.58	221.49
1900	28.9	61.33	212.21
1	28.5	58.95	206.85
2	30.4	52.16	171.58
3	30.7	53.57	174.50
4	30.8	57.22	185.78
5	31.0	60.35	194.68
6	32.0	66.79	208.72
7	33.6	65.33	194.43
8	32.4	52.86	163.15
9	34.9	51.50	147.55

CONSTANT DOLLAR OR REAL PRICE OF SILVER (Continued)

Year	E52 WPI (Warren and Pearson)	Average Price — Silver, New York, Current U.S. cents	Constant Price, U.S. cents per ounce — Silver 1967 = 100
1910	36.4	53.49	146.95
1	33.5	53.30	159.10
2	35.6	60.84	170.90
3	36.0	59.79	166.08
4	35.2	54.81	155.71
5	35.8	49.68	138.77
6	44.1	65.60	148.75
7	60.6	81.42	134.36
8	67.6	96.77	148.15
9	71.4	111.12	155.63
1920	79.6	100.90	126.72
1	50.3	62.65	124.55
2	49.9	67.53	135.33
3	51.5	64.87	125.96
4	50.5	66.78	132.24
5	53.5	69.07	129.10
6	51.6	62.11	120.37
7	49.3	56.37	114.34
8	50.0	58.18	116.36
9	49.1	52.99	107.92
1930	44.6	38.15	85.53
1	37.6	28.70	76.33
2	33.6	27.89	83.01
3	34.0	34.73	102.14
4	38.6	47.97	124.27
5	41.3	64.27	155.62
6	41.7	45.09	108.13
7	44.5	44.88	100.85
8	40.5	43.23	100.74
9	39.8	39.08	98.19
1940	40.5	34.77	85.85
1	45.1	34.78	77.12
2	50.9	38.33	75.30
3	53.3	44.75	83.96
4	53.6	44.75	83.49
5	54.6	51.93	95.11
6	62.3	80.15	128.65
7	76.5	71.82	93.88
8	82.8	74.36	89.81
9	78.7	71.93	91.40

CONSTANT DOLLAR OR REAL PRICE OF SILVER (Continued)

Year	E52 WPI (Warren and Pearson)	Average Price — Silver, New York, Current U.S. cents	Constant Price, U.S. cents per ounce — Silver 1967 = 100
1950	81.8	74.17	90.67
1	91.9	89.37	97.25
2	88.6	84.94	95.87
3	87.4	85.19	97.47
4	87.6	85.25	97.60
5	87.8	89.10	101.48
6	90.7	90.83	100.14
7	93.3	90.82	97.34
8	94.6	89.04	94.08
9	94.8	91.20	96.20
1960	94.9	91.38	96.29
1	94.5	92.45	97.83
2	94.8	108.37	114.31
3	94.5	127.90	135.35
4	94.7	129.30	136.54
5	96.6	129.30	133.85
6	99.8	129.30	129.56
7	100.00	154.97	154.97
8	102.5	214.46	209.23
9	106.5	179.07	168.14
1970	110.4	177.08	160.40
1	114.0	175.20	153.68
2	119.1	168.46	141.44
3	137.4	255.76	186.14
4	160.1	470.80	294.07
5	174.9	441.85	252.63
6	183.6	435.35	237.12
7	194.2	462.30	238.05
8	209.3	540.09	258.04
9	235.6 1109.38	470.87	
1980	268.8	2063.16	767.54
1	293.4	1051.84	358.50
2	299.3	794.73	265.53
3	303.1	1144.13	377.49
4	311.7	897.2	287.87

An ounce of silver still had the same purchasing power in 1984 as it had in 1871, 113 years ago. It has maintained its value. Many other materials have not.

Source: Professor G. Anders.

After U.S. President Richard Nixon divorced the connection between the U.S. dollar and gold (and therefore silver), what happened was that:

1) both silver and gold continued as the stores of value, while

2) the U.S. dollar continued as the main world medium of exchange, the so-called world's "reserve currency".

Since the time that President Nixon shut the gold window in 1971 and Switzerland stopped supporting the U.S. dollar on January 24, 1973, there has been a general fall in the value of all of the world's currencies against gold and silver in the intervening decade.

At the height of inflation several years ago, the value in gold of European paper currencies was reduced to half every five years. Today, with inflation somewhat lower, these currencies and the U.S. dollar lose half their value about every 11 years. Since early 1983, the value of the U.S. dollar and the Japanese yen has slightly strengthened against gold, but the value of the British pound and the West German mark against gold remained steady.

A single 1911 Canadian silver dollar sold in 1984 for about $300,000. The 1981 Canadian silver dollar sold for almost $17 in 1981, but sells at between $55 to $65 today.

SILVER PRICES ARE HIGH TODAY, NOT LOW, IGNORING THE ABBERRATIONS OF 1980.

The dollar is sure to buy less gold (or less silver) in the future and less of everything else.

The gold price, (whether expressed in U.S. dollars, Japanese yen, D-marks, Swiss francs or U.K. sterling), escalated from a "low" of U.S. $35.94 an ounce, the average, (in U.S. currency), in 1970, to a mid-June, 1984 level of under $400, (although it did go to twice that for a relatively short time in 1980). The 1984 average was U.S.$360.44.

Partly reflected in this price strength is the fall in gold output after that same year, 1970, when total world mine production of gold peaked and has been falling relentlessly ever since. (This is not fundamentally reversible under any foreseeable scenario, barring an incredibly large find somewhere).

With regard to the permanence of the value of silver and gold, an early 1984 report by the International Gold Corporation, the marketing arm of the South African gold-silver mines, reported on how gold fared in comparison to stocks, bonds and money in the bank over the last 15 years in six major nations. See chart.

During 1977 through 1980, a period of rapid inflation, the most dramatic rise in the price of gold, in the local currency, was in Canada, 50.6 per cent. Those who held gold (or silver) in Canada therefore received more protection than in the other countries.

In 1980 to 1983, a period of deflation, which was ending early in 1984, the gold price in Canadian dollars declined by only 6.4 per cent. For the longer period 1977-83, the gain averaged 19.5 per cent. One must conclude therefore that buyers of gold in Canada benefitted more than in any other of the six nations studied in that period.

A similar picture could be demonstrated for the silver price. The surge in the silver price late in 1979 was followed by the historic high in late January, 1980 of U.S. $50 (then equivalent to 21.65 pounds sterling).

3.2 THE FREE MARKET IN SILVER

The silver price was set free only 18 years ago in 1967; gold in 1968. In the late 1960's and early 1970's silver was about U.S. $2.00 and gold $35-42.

The average free market price picture for silver could develop as follows:

1982	1983	1984	1985 est.
U.S. $7.95	11.45	8.1495	9.00 to 12.00

Silver and gold have started to come back into their own as inflation has been spreading and accelerating throughout the world. Early in 1984, U.S. interest rates were at historic highs, when adjusted for inflation. People in higher income brackets continue to build inflation expectations into their personal planning.

Silver and gold prices are the monetary reflectors of our economic times.

Silver, which has been an inflation hedge of the relatively poor, will undoubtedly be used more and more for this purpose by the lower income groups as inflation continues to accelerate.

> "Gold is for the mistress — silver for the maid —
> copper for the craftsman cunning at his trade."
>
> —Rudyard Kipling, "Cold Iron".

The fact that citizens in some countries are forbidden to buy gold bullion intensifies the upwards pressure on the price of silver — the normal alternative — and continues its monetary image as the only substitute for gold as a store of value.

In any case, barring a world depression or a world war, it appears that current inflation, value of the dollar and mineral taxation levels would seem to militate against a return to the nominal price range of the early 1970's for silver and other metals, although I should remind you that silver was trading at only $1.40 an ounce as recently as about twelve years ago.

NO GOVERNMENT, FIRM OR PERSON CAN CHANGE THE FACT THAT THE WORLD CONTINUES TO CONSUME MORE SILVER THAN THE WORLD'S MINES PRODUCE.

Factors on the supply side influencing the silver price include:

1) world mine production of silver;
2) recovery of silver from a variety of forms of industrial scrap;
3) the conversion of coins and artifacts into silver bullion;
4) individual holdings of imported silver
5) industrial needs for base metals and gold from mines producing silver as a byproduct.

On the demand side, some of the factors affecting the silver price are:

1) the industrial, medical and dental uses of silver;
2) competition from substitute metals, plastics etc.;
3) private hoarding of silver, gold, platinum etc.;
4) silver coinage and commemorative issues;
5) sterling silver uses in flatware for the table, in jewellery etc.

In the foreseeable future, the silver price will be unavoidably tied into a price ratio to gold and the silver supply level will also be increasingly locked in to the demand situation for low grade copper deposits and of other base metal ores. Such demand is expected to be relatively poor through 2000.

3.3 FORECASTS OF THE SILVER PRICE

"It is better to be roughly right than precisely wrong."

"A creative mess is better than tidy idleness."

The study of silver involves three basic factors:

1) Demand for Silver;
2) Supply of Silver;
3) The Price of Silver, which itself is the balancing agent between the first two, in a free market.

Silver price forecasting is harder to get right than gold price forecasting, since gold itself has quite an effect on the silver market. Formalized forecasting of the silver market is virtually impossible for these reasons:

1) silver is produced primarily as a byproduct of other metals and
2) silver in many countries plays a monetary role as a store of value of last resort, exceeding in several cases even the role of gold. India and Southeast Asia constitute a vast reservoir of silver hoards from which supplies flow during famines etc. or when prices are high. Even in the West the secondary supply from silverware, hoards and heirlooms can be significant when the price of silver is high enough.

The silver price can be volatile. It averaged U.S. $4.50 an ounce in 1978 but jumped to a 1980 high of U.S. $48. However, it has, during the last 10 years, ranged between U.S. $5 and $15 about 55 per cent of the time and has been above $15 only 17 per cent of the time.

SILVER PRICES ARE MORE VOLATILE THAN THAT OF GOLD. For example, over the period from June to September, 1984, December silver fell 30.3 per cent, rose 18.8 per cent, then fell 15.1 per cent, according to DJL Futures Research in September, 1984.

In the U.S.A., the silver price was freed in 1967 and soared dramatically in both 1974 and 1980, but each time plummetted just as quickly to a much lower level. It is unlikely that the 1980 high will be seen again for several years, barring a major war or a sensational world boom. The silver price, in real or "constant dollar" terms, actually declined between July, 1981 and July, 1984.

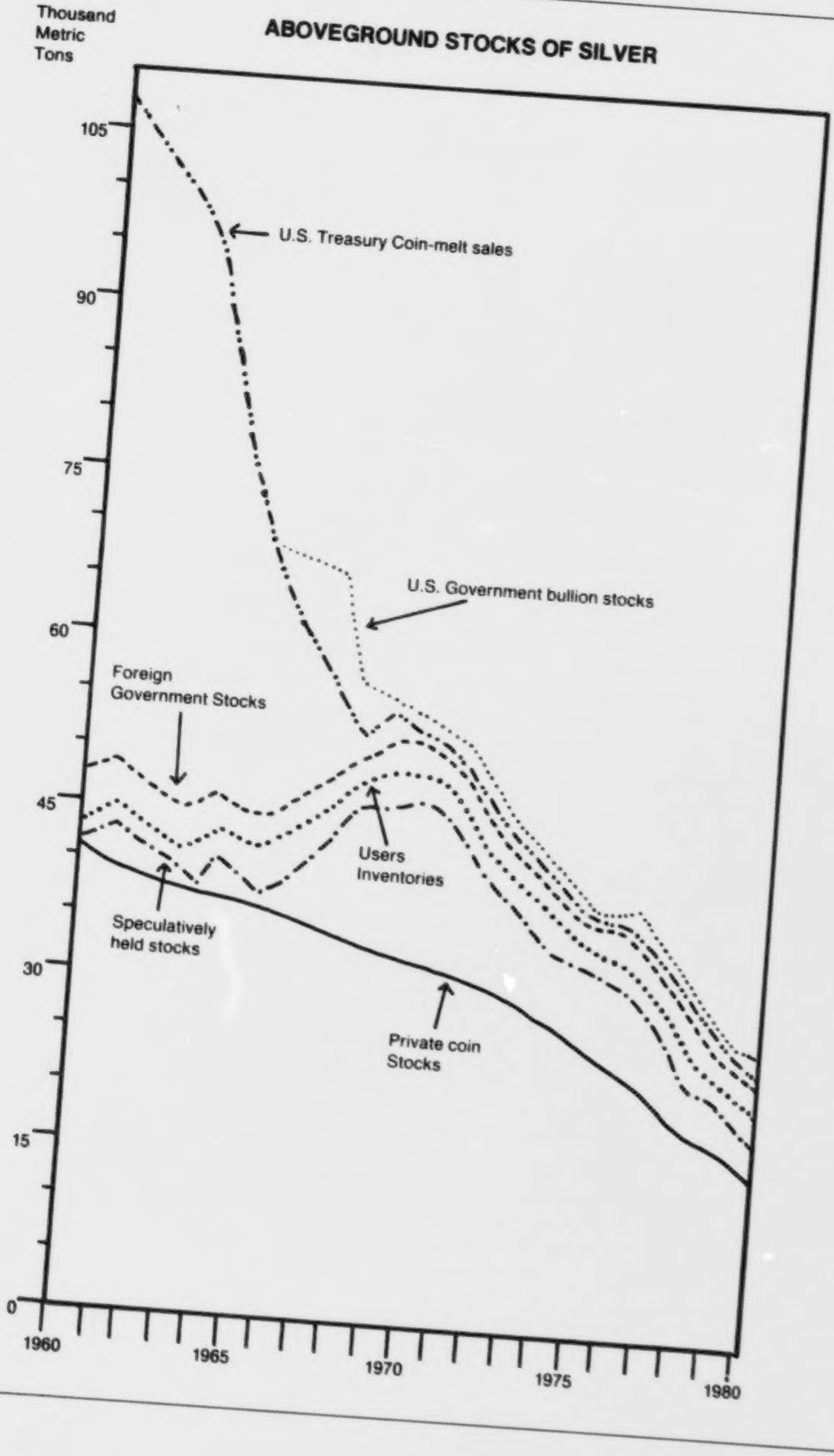
There are a few economists and analysts forecasting a significant deflationary period with much lower silver, gold and other metal prices and lower prices for other commodities, i.e. prices will get worse before they get better.

The high for silver in 1983 was U.S. $14.74 spot or $16 in futures. The high in 1984 was $10.064 on March 5 and the low $6.294. Gold went below $300 on January 4, 1985, averaging U.S.$360.44 in 1984.

Most precious metals market analysts expect silver and platinum prices to rise much faster than gold when the economic improvement commences, particularly the silver price. The outlook for the silver price is very good. Of all the important metals mined, silver appears to be the one most likely to offer the highest percentage increase in revenues per unit produced over the next decade. Gradual strengthening of the world silver price should improve the earnings of base metal mines, many of which produce silver as a byproduct. As the silver market improves, a number of small silver-cobalt mines may again become profitable.

A deep study of the silver price must be based in part on gold and gold's price expectations. Hopes for high gold prices in the future hinge partly on predictions of a major falloff in the mid-1980's in South African gold production. This is valid if the further reasonable assumption is made that such a fall-off in production from known South African deposits cannot be compensated for in the increased total world consumption by either new technology or increased production anywhere else in the world, including production from major new mining camps, and gold recovered from scrap. There is a need to be continually sensitive to and on the lookout for such developments when we keep in mind that gold output often responds to real price changes just like any other mineral commodity.

Gold remained at over U.S. $300 an ounce for the five years through July, 1984. It dropped from its historic highs of 1980 to a 1984 high of U.S. $404.60 on March 5, 1984 to $332.50 in July, 1984 and to U.S. $327 on November 27, 1984, for the third or fourth time in three months. Gold closed the year at U.S. $307.90 spot, a two and half year low, and silver at $6.295 spot.



ABOVEGROUND STOCKS OF SILVER

Silver is a commodity which cannot be easily influenced by national governments because government stocks hardly exist any more. They are almost sold out.

The U.S. Treasury's enormous stock of silver was held in large vaults at the U.S. Military Academy at West Point, New York.

In the final analysis, silver prices also react in part to the regularly published level of non-government above-ground stocks, which were at their highest level in modern history towards the end of the first half of 1983, according to CRU. When these stocks show significant moves, they often trigger waves of buying or selling.

Silver should show extremely favourable price increases in the future compared to the prices of base metals, particularly when looked at in constant dollar terms. However, in the short term, it could drop to U.S. $4.00 an ounce.

Silver is perhaps the one metal for which a slightly rising "real price" or "constant dollar" price trend through the second half of the decade is more likely than for any other. Increased uses of silver could occur in the area of water-purification and many other catalyst applications, for example.

How well do forecasters do? (Such forecasts, of course, do not preclude a dip or two below present levels before the gold and silver prices rise.)

Well, to take one example. From June 1974, the Foundation for the Study of Cycles ran a series of cyclical studies which showed the most dominant component in silver prices indicated that the next ideal peak in silver prices was estimated to occur during the summer of 1985, but in the meantime the price *would decline to about the summer, 1982.* It did decline steadily for five years and nine months, (apart from the "corner" run-up in January, 1980), with the end of June, 1982 marking the lowest silver price after October, 1976.

The World Bank projected that the silver price would increase from U.S. $4.71 an ounce in 1974 to $9.35 in 1980 and $16 in 1985. These are equivalent to $5.70 in 1980 and $7 in 1985 in constant 1974 dollar terms.

Charles Stahl of Princeton, a veteran precious metals forecaster, said early in June, 1983 that "huge fortunes will be made in silver (trading). But first you must learn how to intelligently trade the metal". His contention was that substantially higher silver prices would be seen within the next 8 to 10 months, i.e. by early February, 1984 to April, 1984, and that U.S. $19.50 would be reached. It was not.

Samuel Montagu, London merchant bank/bullion dealer, says that gold's new range is U.S. $350 to $400 but speculative interest in silver is by no means dead and only a modest increase in inflationary expectations would uncover a potentially large volume of investment buying of silver.

Scott D. Dial, the Texas silver expert, said in late 1982 that if historic trends continue, he looks for silver prices to soar to over U.S. $170 by 1986, adding that that is a minimum price.

In January, 1984, Conti Cyclic Projections said that the silver price appears to be headed for the June, 1982 low of *U.S. $6.30* and that this level would be reached sometime in *May, 1984.* By the end of May, 1984 it had actually only gone down to about $9.00, but was in the $7 range by August and $6.295 at the end of the year.

The 1982 low was U.S. $4.89 an ounce, according to Shearson Lehman/American Express, London, in 1984, who added that it will have difficulty in future in rising above U.S. $10.

Fred Collender of Strauss Turnbull, London, said in mid-1984 that gold should be at $360 to $420 for two years, barring the unexpected.

The Silver Users Association stated that it was reasonable to expect relatively stable prices for silver in the U.S. $7 to $10 range, at least through the first half of 1984, an accurate forecast. The Association believes that the average 1984 silver price will not surpass the 1983 average of U.S. $11.44 an ounce. It did not.

Sinclair de Marinis and Company, New York, said in February, 1984, that we would most likely see a low of *U.S. $6.50* to $7.00 for silver and we saw $6.295 by the end of the year.

In their Annual Metal and Commodity Review early in 1984, Rudolf Wolff and Company Limited of London (Noranda) said that a silver price decline to below U.S. $7.00 would not be unexpected, particularly if the dollar remains strong. It went down to $7.00 in August and $6.295 at end-year.

Charles River Associates 1980 report correctly forecast what the silver market would do after the 1980-81 run-up and fall. Charles River Associates stated early in 1984 that silver prices in 1984 will continue to be highly sensitive to industrial demand — more than any other metal — but the silver price will be highly volatile. In the long run, a price of less than $11 in 1983 U.S. dollars is foreseen by them, probably meaning by 1994.

Metal Analysis and Outlook of London felt compelled to reduce their forecast for gold to U.S. $390 to $430 but continued to expect strong speculative-investor interest through the second and third quarters of 1984 to push the silver price up, perhaps beyond U.S. $12 an ounce, which did not develop.

Metals and Minerals Research Services of London forecast an average price for silver through 1990 of only a little over U.S. $10 an ounce.

HAL Commodity Cycles forecast in May, 1984 that gold will drop below U.S. $350 and silver will fall below $8.00. They did, later in 1984.

Gold went down to U.S. $332 in July, 1984, a two-year low. It was $510 in February, 1983.

Canada's federal government stated early in 1984 that an average silver price of $13 an ounce in 1983 dollars will be adequate to keep world supply and demand in balance over the medium term.

The eminent Swiss bank, Credit Suisse, estimated that world demand for silver should increase faster than supply in 1984.

It said in the summer of 1984 that an uptrend in the silver price is clearly becoming discernible, but this did not hold.

Russ Wasendorf in Futures Portfolio Advisor, in September, 1984, expected renewed strength in precious metals with particular strength in the silver market, expecting a sustained rally in December silver to the U.S. $8.00 level. The month closed at $6.295.

International Moneyline Weekly successfully forecast that U.S. citizens would be permitted to own gold in 1974; predicted the bear market in gold in 1975; identified the new bull market in gold which began in 1976 and forecast the U.S. $500 or better gold price in the explosive year of 1979.

With similar methods and consideration of higher oil prices it correctly predicted the bear market in gold which began in 1980. In the fall of 1983, it forecast that gold would not fall below U.S. $350 and early in 1984 it believed that a new bull market will soon be at hand, following its low mark of $362. In 1984, Julian Snyder, the editor, said that the price of gold is going to U.S. $1,000, $2,000, perhaps $5,000. Nothing is more certain, he said.

There could be a very definite shortage of physical primary silver from 1985/86 onwards said The Western Monetary Report, Winter 1982/83, Fort Collins, Co. It added that silver will be at more than U.S. $100 an ounce, with gold at U.S. $2,000 an ounce, in the next 24 months, i.e. by end-1984/early 1985.

Irwin Shishko Associates Inc., of West Stockbridge, Mass. stated, in a careful and professional analysis, that the potential is growing for a significant silver advance by year end (1984).

Ian McAvity, editor of Deliberations, Toronto, has gone on record saying that gold will be around $2,000 by the peak of the 1986 cycle. He says that silver is generally a better buy than gold when the ratio climbs above 45:1, as it was in the fall of 1984. He repeated in the November 22, 1984 issue of Money Letter that he continues to be bullish on gold and silver for 1985.

In October, 1984, he believed that the cyclical low for gold is the U.S. $332.50 London price of July 9, 1984, adding that precious metals prices had been *rising* for 6 months in Swiss francs.

In March, 1984, Precious Metals Monthly Review said that by end-1984, gold should be in the U.S. $500 range. It was not.

Jerome F. Smith, the author, said in the early 1970's, when silver was about U.S. $1.40 an ounce, that the price would exceed $20 by the end of the decade. It did. He said that by early 1984, he thought we would see something close to U.S. $20 an ounce for silver. We did not. It was only around $7.00 by August. He said early in 1983 in the Silver and Gold Report, that silver would go to over U.S. $100 and then to $200 by *1986*. He added in June, 1983 that the current 35:1 ratio of gold to silver prices will *soon* drop to 20:1 (or lower) as the silver price (and profits) rise faster than gold. The ratio did not drop. It rose.

He has also singled out the following reasons why silver is the premium investment medium for the 1980's:

1) market supply is inelastic: (Many observers disagree.)
2) market demand is inelastic: (Many observers disagree.)
3) technological advances are creating new demands for silver, or are lowering its mining and refining output costs and
4) there is minimum political interference in the silver market in the Western world.

On the latter point, the Silver and Gold Report points out that

1) silver has no history of confiscation in the major industrialized countries, (unlike gold). (Rather than confiscate gold, the U.S. government is more likely, at first, to concentrate on ensuring that people pay their taxes on the bullion).
2) the bulk of the world's silver mining is mainly in friendly countries, Canada, U.S.A., Mexico, Peru, Australia, Chile, Japan etc. (Confiscating silver would damage the friends of the U.S., as well as many other people at home).
3) silver is not viewed as an important reserve asset of major governments. Silver bullion reserves of governments represent less than one per cent of the value of gold bullion reserves: silver is a minor monetary asset in the view of governments like the U.S.;
4) silver is an essential industrial metal — vital for electronics, photography, medicine, surgery, engineering etc. etc.

Incidentally, the Silver and Gold Report successfully forecast the bottom of the silver price in 1982, almost to the day and only 22 cents off. They said the bear market in silver was about to end and it did, three days later. The newsletter believes that the long-term base (minimum) price is U.S. $7.00 an ounce. At end-November, 1984, S&GR warned that silver would probably tumble below $6.50 an ounce. It did, in December, when they added that the silver price may test the old June, 1982 low of $4.88.

Jerome Smith, editor of Australian Investment Perspectives, says that by 1986, he expects to see gold reach U.S. $3,000 an ounce.

A. Owen, the publisher, stated in June, 1983 that silver could easily reach U.S. $150 an ounce and the cycle top in late 1985 will take gold to the U.S. $3,000 area, (which is a 20:1 ratio, like Smith's).

Gold will rise in late 1984 with (downward) corrections. Silver will actually outperform gold (in the percentage rate of increase in the price). Gold will hit U.S. $1,500 by spring, 1985 and could soar through the $2,000 ceiling by January 1, 1986. These are the predictions of Personal Wealth Digest.

Richard Young, Editor of Young's World Money Forecast, has an enviable track record in that he forecast the top of the gold market in 1980 as well as the bottom in 1982, right on the mark each time. He said in January, 1984, that low inflation is one of the reasons why the gold price turned down late in 1983 and no-one would argue with him on that.

He feels that the proper price ratio between silver and gold is 10:1 to 12:1, the ratio of the "availability" of silver and gold in the earth's crust and that points to U.S. $40 an ounce for silver, he says. One might have a problem in following that logic in light of how the silver market works. One should start with the wide distinction between resources and reserves in such a discussion.

A similar notion has been put forward by Lewis E. Lehrman, who said, on the subject (of the re-establishment of gold and silver standards for currency conversion by 2000) as a first approximation, currency convertibility rates should be U.S. $500 for gold and $10 for silver, based on the marginal North American costs of producing a unit of silver or gold, plus a profit.

However, with inflation rising modestly from the January, 1984 level of just over 3 percent, by the fall to 5.5 percent and to 6 percent by end-1984, Richard Young saw it doubling in 11 months. This would be considered by many to be bullish for gold and for the silver price.

He added that, with inflation rising, one should buy precious metals now at these low prices.

On silver, Richard Young was extremely conservative in the short term, saying that the downside may be U.S. $3.00 an ounce at the worst, with the upside $8.00.

Expecting the stock market to top out in 1984, he felt that such a development would make precious metals more competitive.

The economic cycle may have past its momentum peak. An increase in the trend rate of inflation provides the basis for generally higher silver and gold prices.

Summing up, he felt that both silver and gold would make only modest price gains in 1984. He said in January 1985 that the climate is not right for a major cyclical advance in gold and silver prices in 1985.

Lufkin and Jenrette Futures of White Plains in 1984 did not see any dramatic increases in the price of either gold or silver.

ACLI International Commodity Services said in March, 1984, that their near term view for precious metals calls for higher prices, but only marginally so.

ACLI believed (May, 1984) that platinum and especially palladium, could move higher and are likely to out-perform gold and silver, (in percentage increases in price).

The Powell Monetary Analyst said in April, 1984 that although it did not expect a return to 1979-80 price levels soon, silver will have intermediate runs both up and down, especially if commodity exchange silver stocks show big (up or down) moves.

The James McKeever Strategy Letter said that it did not think that precious metals would have a roaring bull market until after the U.S. election, November, 1984. He recommended in December, 1984 that people hold only insurance positions in precious metals, adding that he would go to silver. "It might make you 10 or 20 per cent next year (1985) but I do not look for it to go dramatically upward, unless there is a war", he said.

Franz Pick said "Do not sell any silver or gold from this point on". He believes "silver will go up to at least U.S. $20 in the not too distant future".

In contrast to some forecasts, CRU Consultants Inc., in their 1983 study, came to the conclusion that the price of silver will be substantially below the range of U.S. $15.00 to $20.00 over the long term.

One should perhaps mention here that if silver had matched the compounded growth rate of all wholesale commodities since 1792, silver would now be selling at U.S. $15.40 an ounce.

Silver has a long run equilibrium average annual real (constant dollar) price of below U.S. $15 an ounce. Harry Browne of Vancouver, British Columbia, Canada however, believes that the equilibrium level for silver, its fundamental value, is actually somewhere in the area of $10 an ounce.

Silver has never sold at above U.S. $15 an ounce, except for a period of 18 months in 1979-80.

Peter Cavelti, President and Chief Executive Officer, Guardian Trustco International, Toronto, Canada, the distinguished Swiss international banker and author of the late 1983 book "Gold, Silver and Strategic Metals", said in February, 1984 that he expected that if silver consumption continues to outstrip production, silver will outperform gold. (Guardian Trust is almost certainly Canada's most profitable financial institution). He added in June, 1984 that, with regard to Third World debt levels, the alternatives of default on the one hand, or a better loan structure on the other, would remove the immense pressure now felt by Third World nations to produce (base and precious) metals at almost any price just to raise foreign exchange. It may take a few years for supplies of silver to start declining again, but when (and if) they do, the impact on the price may be staggering. He also advised investors to remember that although the silver price has the ability to rise faster than gold, silver invariably drops faster than gold. He also feels, like ACLI, that palladium and platinum will dramatically out-perform gold and silver. He said in October, 1984 that gold would (eventually) peak at $500-$600.

World demand for platinum should continue to rise during 1985 according to the Chairman of Rustenburg Platinum — October, 1984, adding that he expected world demand for platinum in

1984 to be between 15 and 20 per cent higher than 1983.

Paul Sarnoff, the eminent precious metals trader and writer of 27 books on metals trading, who is currently considered by some to be the leading silver bull, said there is a good chance that silver will recover from the 1984 lows and forge ahead toward the $15 per ounce level again.

In June, 1983, he forecast that

1) "Whatever the price of gold at the end of the next five years, (mid-1988), the platinum price will be *twice* as much". "We will look back four or five years from now and wonder, 'How could that stuff ever have been so cheap?' ". (Since the gold price was freed in 1968, the price of platinum has exceeded gold during most of that period).
2) "Palladium will (then) sell for *more than* gold."

His confident expectation of $80 an ounce silver in the (late) 1980's is based on continuing shortfalls in the U.S.A. and in the Soviet Union, and on the constantly growing population of the Third World, which wants our silver-bearing gadgets and will get some of them.

Other analysts are also persuaded that, by about the middle of the current decade, (say end-1985/early 1986), silver could show very favourable price increases compared to base metals.

J.P. Ingersoll of the eminent firm of Salomon Brothers said in April, 1984 that the next 12 months, i.e. by early April, 1985, would see silver at U.S. $13 and gold at $475-500, (a silver/gold ratio of 36.5 to 38.5 to 1).

James U. Blanchard III spelled out ten reasons in March, 1984 why he thought the price of gold is headed to U.S. $1,000-$1,500 by 1986 and the silver price should go to between U.S. $50 and $75 by the same year. (n.b. Gold saw a low of U.S. $307.90 in 1984).

1) The supercycle favours gold (and silver). (This means that gold and silver do not lose their value over the centuries.)
2) U.S. government spending is apparently out of control, he said.
3) The world debt explosion. Huge growth in spending by governments results in expansion of world debt, particularly the U.S. government debt. The President's Grace Commission, headed by eminent businessman J. Peter Grace, predicts that U.S. budget deficits will reach U.S. $1 trillion a year by 1990 — only five years away. There are calls to "soak the rich". However, in the case of the U.S.A., J. Peter Grace has recently pointed out that even if you confiscated all individual income in his country above U.S. $75,000 a year, you would only net enough to keep the U.S. government going for about ten days a year.
4) World bank crisis will re-assert itself. (Troubled developing nations owe major western banks and governments an enormous U.S. $800 billion.)
5) Supply and demand situation favours gold. Economic recovery continues strong. Real increase in personal earnings and consumer spending will strengthen gold (and silver) jewellery sales and so on.
6) U.S. monetary inflation favours gold. Consumer Price Index should reach double digit levels and in 1985 should be at double digit levels on a year-to-year basis. Gold should therefore move sharply higher.
7) The long bull market is finally over. A big move against the U.S. dollar will eventually come.
8) A massive new investor demand for gold — could be astronomical in the U.S.
9) Central Banks of the gold-holding nations now have new reasons to be favourable towards gold. Every U.S. $100 per ounce rise in the price of gold means a gain in the value of Central Bank reserves of U.S. $82 billion.
10) World crises will favour gold prices.

A 1984 study done by the respected firm, Economic Consulting Services, for the conservative Chamber of Mines of South Africa, (the organization of the main gold/silver mining companies there and owner and operator of the world's single largest gold refinery and therefore having a vested interest in a high gold price), stated, in its "most probable" economic scenario, that "the nominal gold price should reach about U.S. $1,000 an ounce just over five years from now," i.e. say by the fall of 1989.

The study comprised five distinct scenarios. It foresees a gold price ranging all the way between U.S. $398 and $1,971 in nominal terms by 1990.

Their "most probable" price scenario assumes neither runaway success nor economic stagnation, with annual world inflation taken at 6 per cent, real world interest rates at around 4 per cent and world gross national product at an average 2 per cent.

The further assumptions in the report which lead to the long range projections are:

1) Annual Supply of gold will total only some 1,300 metric tons, of which 960 tons will be from the free market and an assumed 300 tons from the Soviet Bloc.

2) Annual private investment demand will reach 380 tons.

3) A market clearing price for gold of U.S. $400 an ounce was assumed for early 1982 — the base year for their forecasts.

Sir William Rees-Mogg, former Editor-in-Chief of the Times of London and co-publisher of the London-Washington Insider Report, said that, in the most dynamic phase of the bull market in 1984 and 1985, gold should soar to at least 2 or 3 times its present dollar value and potentially a great deal more. He expects the peak to be in the area of U.S. $750 to $1,000. This would certainly help the silver price.

A survey conducted in May, 1984 in South Africa among prominent economists, investment managers and brokerage house analysts covered the outlook for gold in the next six months. 49 per cent saw the price going higher and only 17 per cent saw it going down potentially. 11 per cent described themselves as "very optimistic" and only 3 per cent as "very pessimistic". South Africa, of course, desperately needs a higher gold price.

The survey appeared to show that one's optimism or the reverse depends on views of future U.S. interest rates and inflation rates, plus Third World country debt and the chronic Middle East crises.

One expert said that if gold goes under U.S. $360, it could fall to $300. It did, late in 1984.

A Rand African University (South Africa) study says that the gold price will rise slowly to U.S. $500 average by late 1985 and then slide again.

The Chairman of Rand Mines, Blyvoor and Harmony gold mines in South Africa, forecast in August, 1984, gold prices of over U.S. $400 an ounce in 1985 and an upward trend thereafter, based on a weakening U.S. dollar and inflation moving upwards. The Chairman of Gold Fields said that the gold price is unlikely to rebound significantly for at least 6 to 12 months.

The South African government's Mineral and Energy Affairs Department in 1984 forecast an average gold price of U.S. $370 an ounce in 1985, largely in anticipation of a weaker U.S. dollar.

The Armstrong Report of Princeton Economic Consultants, New Jersey, has a very good track record. It projected the precise day that gold peaked in 1980; projected every major turn between 1980 and 1982 pinpointing the precise low on gold to within $1.00 and then immediately projected that gold would rally back to U.S. $500 and peak during the Labour Day week of 1982; projected the high on gold for the week of February 14, 1983 and forecast a drop of $100 in a panic sell-off. Gold dropped by $119. The Report, in June 1983, warned that gold would continue in a bear market into 1984 and that $400 would never hold. In December, 1983 the Report forecast that silver would fall and hold U.S. $7.83 on a closing basis and would rally back to test the $10.00 level and then turn downwards once again. It added in 1984 that gold remains in a bear market and has failed to reverse that trend. It will not turn bullish until it closes above U.S. $431 on a monthly basis and meanwhile gold's bear market trend will take it down to levels never thought possible. This is an excellent level of professional forecasting. Incidentally, the PEC hourly rate for private consultation is U.S. $4,000 per hour.

In January, 1984, Andy Sarlos of Toronto successfully predicted weakness in gold in 1984, a market decline and a nerve-wracking 1984 and felt in late July/early August that with gold down to U.S. $330 an ounce it is close to the probable 1984 bottom, which he doubted would be below U.S. $300. An almost perfect prediction.

In September, 1984, Alexander Doulis of Daly Gordon Securities, Toronto, predicted that gold will reach the U.S. $460 level in the next 12 months, say by August, 1985, citing a weakening U.S. dollar, currency fears and lower interest rates as factors.

When gold was at U.S. $130 at end-1976, the famous Aden sisters said that gold had bottomed and it was time to buy. An excellent call. In 1978, with gold at $200, the sisters predicted that gold would sell for $700 to $800 in 1980 and in the event, the price reached $850 on January 18, 1980.

In October, 1980, when gold was U.S. $670 and when other forecasters were telling people to hang on for U.S. $3,000 or more, the Aden sisters warned of a two and a half year bear market in precious metals, saying that gold would drop to between $300 and $320 between March and July, 1982. It did, dropping to $296 on June 21, 1982. Right on.

At mid-1983, the sisters said that gold would go higher and might possibly hit U.S. $850 by mid-1984. Well, it did not, unfortunately for their track record. It did not even reach half of that price. In late 1983 they said one should sell gold at U.S. $388. Within days it fell to $366. A good call.

In spite of the fall in gold from the U.S. $400 level in 1983, the two Aden sisters, who normally have such an eviable track record in forecasting economic events, including silver and gold prices, said in January, 1984 that they were still forecasting a bull market in which the peak is likely to come in 1986. The second half of 1984 should be the turning point, with major resistance at U.S. $350 for gold. End-1984 should see prices for silver and gold up by 50 to 100 percent. It did not. They also felt that gold should outperform silver in the remaining months of 1984.

They project that both silver and gold will rise slowly and steadily over the next year or so, with gold then at U.S. $700 an ounce and silver at U.S. $14 to $16. After that, both will take off dramatically, with silver outpacing gold.

They further said that gold will go to a cyclical price peak between September, 1985 and September, 1986, reaching U.S. $3,000 in early 1986, which is only months away but they now concede that that is incorrect. However, they have talked of a cycle peak in 1987 or 1988.

If gold goes to U.S. $3,000, silver should go to at least U.S. $100 an ounce and could hit U.S. $125 to $150, they said. They did add, however, that if a bear market for gold is confirmed in mid-1986 and the price is only $2,500, they are not going to argue. They will get out. This pragmatism shows they are not prisoners of their charts.

More important than their high forecast of an eventual price of U.S. $4,000 an ounce for gold, they said, was the fact that we were, January, 1984, in a major bull market which will push prices to all-time highs, according to their analysis of leading indicators. A major bull market in gold is pointed up, they said.

They said in Wealth magazine in the spring of 1984 that gold will double (in price) in 12 to 15 months and then explode up from there in the following 24 months, i.e. to the spring or summer of 1987.

Silver is a better buy than gold, according to the Aden sisters and many others, with the sisters adding that if gold goes to U.S. $4,000, silver should go to at least $120 an ounce and in the final stages of the bull market could reach the $140 to $150 level. They have offered technical evidence for U.S. $125 silver by 1985-86, with gold around $4,000, i.e. a ratio of about 32:1 by that time. Even at 50:1, silver would be U.S. $80 an ounce at $4,000 gold.

In December, 1984, they said that 1985 will be a good year for precious metals.

In summary, the sisters say that precious metals will remain weak in the short term, but strong in the longer term as higher precious metal prices are inevitable over the next four years.

Jerome Smith, Sid Pulitzer, editor and publisher of the Advance Planning Letter and Hans Sennholz, a professor of economics, all agreed in mid-1984 that metals are poised for a major price jump, but not quite yet. They said silver and gold will trade in a narrow range through most of 1984.

The respected London brokers Phillips and Drew, (29.9 per cent owned by the largest Swiss bank, Union Bank), predicted in March 1983 that a major gold price surge cannot be expected until late in 1984 and then the upwards price movement could be swift. They said that the gold price should meanwhile drift into the upper 400 U.S. dollar area until late in 1984, then the price move could be rapid from perhaps 550 to 700 U.S. dollars between the fall of 1984, (18 months or so ahead), and the first quarter of 1985. Union Bank of Switzerland said in December, 1984 it is of the opinion that the gold price is no longer reacting to news of political crises. Downward pressure on the gold price was considerable and could intensify if the U.S. economic slowdown turns into a recession.

Another major bank, Credit Suisse, said in the same month that a gold price below U.S. $300 an ounce, while not ruled out, was unlikely.

Predictions of Toronto, Ontario, at mid-1984, said that silver and gold prices would resume their upward climb in January, 1985 and vault past their all-time highs by the end of 1985. This is based on:

1) the presumed return of double digit inflation.
2) the ending of IMF etc. subsidies, backed by U.S. banks and ripe for default by Brazil, Argentina, Mexico etc.

THESE SUBSIDIES AND GENEROUS LOANS HAVE EFFECTIVELY ALLOWED THIRD WORLD COUNTRIES TO SELL SILVER, GOLD, COPPER ETC. FROM THEIR ORES FOR LESS THAN THEIR ACTUAL MINE PRODUCTION COSTS.

S.W. Ivosevic, in "Gold and Silver Handbook", 1984, predicts that, by 1988, silver will have attained an average price in the range of U.S. $15 to $20 an ounce and gold U.S. $500 to $550 an ounce.

SILVER PRICE FORECASTS TO 1986

	Pence per ounce	**Per cent increase***
1982	455**	– 11.5
1983	646-720	+ 50.1
1984 (U.S. $10.06 – $11.98)	853-1,015	+ 36.7
1985	947-1,147	+ 12.1
1986	1,051-1,296	+ 12.1

* To mid-point of forecast ranges
** Actual

Source: EIU, London (1983)

Drexel, Burnham, Lambert say that with silver prices averaging over U.S. $8 in 1984, they should average $7.60 in 1985, with a trading range of $6.50 to $9.50 an ounce. They expect supply at 14,555 metric tons to outpace consumption of silver in 1985, estimated as 11,507 tons. Silver recovered from scrap is expected to decline from 2,634 metric tons in 1983 to about 2,200 tons in 1984 and 1985.

Jeffrey A. Nichols of American Precious Metals Advisors says that gold prices will rally in early 1985 as the fundamentals of the U.S. economy slowly shift. If this happens, the silver price should rally too. He predicted that by end-1985 the prices of gold, silver and other precious metals would be higher than at end-1984, conceding that the price of gold may go down through the spring of 1985. He believes that at the first real signs of a renewed inflationary spiral or monetary instability, people will again turn to tangible assets, especially silver and gold, and will do so quickly.

The U.K. World Money Analyst, editor Mark Tier, forecast in February, 1982 that gold would bottom at over U.S. $300 an ounce by June 30 and on June 21, gold reached its bottom at $296.75 an ounce and turned upwards. In August, 1982, the publication advised people to buy gold futures then at $345. Gold went to $509 by September 8. A good call. It identified two factors late in 1984 that could push gold over U.S. $2,000 per ounce by 1987, if they occur together and what could send gold to $300 first. It went just below $300 at the turn of the year.

Harry Schultz predicted silver's low in 1984 at U.S. $7. It went a little below that, but the forecast was substantially correct. He also said that gold's low could be $300 and that was very close. This is excellent forecasting. His minimum downside target for silver is U.S. $5.50 for 1985, maximum downside $4.50, with an upside target minimum of $7.00, maximum $8.00 for 1985.

RATINGS BY SOME MAJOR FORECASTERS OF SILVER, GOLD AND PLATINUM PRICES

(1984)

NAME OF NEWSLETTER	SHORT-TERM			LONG-TERM		
	Gold	Silv.	Plat.	Gold	Silv.	Plat.
Your Window into the Future	7	7	7	7	7	7
Aden Analysis	7	7	7	7	7	7
Investing in Crisis	—	—	—	6	7	4
Money Advocate	3	6	—	6	7	—
Gold Direction Indicator	6	6	6	7	7	7
Financial Success Report	6	6	6	7	7	7
Western Monetary Report	6	6	—	7	7	—
London Gold Forecast	4	4	—	7	7	—
Gold Newsletter	4	4	—	7	7	—
Commodity Investment Analysis	4	4	—	7	7	—
World Market Perspective	4	4	—	6	7	—
Gary Allen Report	5	5	5	7	7	—
Jerome Smith's Investment Perspectives	6	6	—	7	7	—
Elliott Report	2	2	—	7	7	—
Market Alert	—	—	—	7	7	—
Deliberations	7	—	—	7	—	—
Information Line	6	6	6	—	—	—
International Financial Strategist	6	6	6	6	6	6
Donald J. Hoppe Analysis	6	6	6	6	6	6
Dickson Letter	6	6	—	6	6	—
International Investors Viewpoint	5	5	—	6	6	—
Gemstone Price Reports	3	2	4	6	6	6
McKeever Strategy Letter	5	5	—	6	6	—
Gold and Silver Exchange Newsletter Report	5	5	5	6	6	6
Peter Dag Investment Letter	5	5	5	6	6	6
Gold and Silver Forecaster	5	5	5	6	6	6
Investment Bulletin	4	4	4	6	6	—
Let's Talk . . . Silver & Gold	6	6	—	6	6	—
Consultant's Coin Report	3	3	3	6	6	6
Worldwide Investment Notes	4	4	4	6	6	6
Personal Finance	4	4	—	6	6	—
Remnant Review	4	4	4	6	6	6
Silver & Gold Report	4	4	—	6	6	—
Tony Henfrey's Gold Letter	4	4	4	6	6	6
Investment Intelligence	—	—	—	6	6	—
World Affairs Review	4	4	4	6	6	6
Metals Investor	3	3	3	6	6	7
Insider Report	4	4	4	6	6	6
Investor's Market Report	3	3	3	6	6	—
Richland	3	3	—	6	6	—
Terex Report	4	4	—	6	6	—
Monetary Digest	3	3	—	6	6	—
Wellington Letter	3	3	3	6	6	6

RATINGS BY SOME MAJOR FORECASTERS OF SILVER, GOLD AND PLATINUM PRICES (Continued)

(1984)

NAME OF NEWSLETTER	SHORT-TERM			LONG-TERM		
	Gold	Silv.	Plat.	Gold	Silv.	Plat.
Robert Ringer's Tortoise Report	—	—	—	6	6	—
Shelburne Securities Forecast	—	—	—	6	6	6
Green's Commodity Market Comments	4	4	4	6	6	6
Investment Strategist	4	4	4	6	6	6
Bridgewater Associates	2	2	2	6	6	6
International Investment Letter	5	5	5	5	5	5
Trendmaster	5	5	5	5	5	5
Kiplinger Washington Letter	5	5	5	5	5	5

Legend: 1-Very Bearish, 2-Bearish, 3-Moderately Bearish, 4-Uncommitted, 5-Moderately Bullish, 6-Bullish, 7-Very Bullish

Source: Performance Digest, Boca Raton, FL, 1984.

N.B. 3 are "Very Bullish" and 13 are "Bullish" on silver in the short term. 18 are "Very Bullish" in the long term on silver and only 15 on gold. (49 ARE "BULLISH" OR "VERY BULLISH" ON SILVER IN THE LONG TERM.)

The silver price should avoid falling to the 1982 low of U.S. $4.89, but it will have difficulty in rising above $10 an ounce, according to Shearson Lehman/American Express, London in their 1984 Silver report. The company sees little likelihood of any major price increase for silver in 1985, unless the value of the U.S. dollar were to decline, as so many observers predict.

World Market Perspective also said in August 1984 that it tended to favour silver over gold, especially at the then silver/gold price ratio of 44:1. In December 1984, it said that it believes that silver should reach a price of U.S. $10 in the next twelve months.

Donald McAlvaney's Intelligence Advisor expected the first few months of the second half of 1984 to provide excellent buying opportunities in silver and gold as:

1) U.S. inflation is turning up shortly.
2) "real" U.S. interest rates begin to decline, even as "nominal" rates may continue to rise.
3) U.S. dollar begins a long-term decline.
4) the turmoil in the Middle East/Persian Gulf accelerates.
5) it begins to be apparent to investors that the bailout of the large U.S. bank and Third World and Latin American debtors is going to be incredibly inflationary, after the U.S. November, 1984 election.

Metal Trends, in October, 1984, forecast the following prices for silver:

(per Troy ounce)	November 1984 to June, 1985	June, 1985 to June, 1986	June 1986 to June, 1987
Forecast Peak	US$ 10.50	12.00	11.50
Forecast Average	US$ 8.50	10.00	9.50
Forecast Trough	US$ 6.00	7.00	6.00

It expected, early in May, 1984, that the silver price would remain sluggish in 1984. It made the point that improved conditions for the silver market may not be expected until 1986 and after that it will decline slightly.

Robert Ringer, whose books have been read by over 10 million people, said in September, 1984, about the gold price:

1) downside risk over the long term: Zero
2) upside potential over the next one or two years i.e. by August, 1986: 100 per cent to 200 per cent;
3) upside potential over the next 3 to 5 years: i.e. by August, 1989: 400 to 500 per cent.

If any of this happens, it will greatly help the silver price.

Others go on to say modestly that the price of silver may double in the late 1980's or hold at the $30 an ounce level.

A minority said that the silver price could reach $100 an ounce and a few say $150, but some of these analysts were careful to say that it would take to 1989 to reach those levels.

Newsletter Digest talks of the 5½ — 6 year cycle due to peak in late 1985 with doubt that the top will exceed $20, but says evidence accrues for a blow-off in the "following" cycle, adding the question '$200 silver in 1991?'

DLJ Futures Research Group said late in 1984 that a great many investors apparently view U.S. $340 gold and $7.20 silver as a bargain, but said that the next major move for the metals outside their September/October trading ranges will be on the *downside*. The Group's metal analyst said in November, 1984 that, just like gold, silver's ability to hold in the summer of 1984 in face of a strong U.S. dollar and fear of an OPEC collapse, convinced them that, for the foreseeable future, the precious metals have found a rather secure base.

All of this probing into the future appears to indicate strongly that there will be related significant silver price movements upwards.

The world market has been flooded with more paper money than goods and the prices of certain raw materials and foods have consequently risen dramatically. Wholesale and consumer prices will follow. As the day follows the night, the price of silver (and of gold) will rise.

If you are (understandably) skeptical about gold going to U.S. $2,000 or $3,000 an ounce, consider this. In 1984, a 14 karat gold chain sold by weight for 45 roubles per gram which is equivalent to U.S. $2,466 an ounce at the official exchange rate of U.S. $1.00 to Roubles 0.973 — in Moscow, according to James Capel & Co., London, (Hong Kong and Shanghai Banking Corporation 29.9 per cent). Allowing a little something for the cost of fabricating the gold into a chain, it is pretty clear that gold bullion at over U.S. $2,000 equivalent an ounce, with a very small amount of fabricating cost, is already here — in the U.S.S.R.

As Ian McAvity of Toronto has pointed out, one can confidently forecast that Canadians will see $2,000 an ounce gold (Canadian funds) long before Americans will in their currency.

Daniel Rosenthal said in November, 1984 that he expects silver prices will move up nicely in 1985. He thought that a return to inflation rates of 8 to 13 per cent would move the equilibrium level for silver to between U.S. $15 and $20 an ounce.

Mark Skousen has warned that he expects that, for 1985-86, silver will oscillate between U.S. $8.00 on the low side and up to $14.00 on the high side.

The most important thing to grasp is that most, but not all, of the trained observers of note predict a much higher price for gold and therefore presumably silver in 1985-88, but without agreement on the actual dollar figures.

Of all important metals mined in Ontario, silver appears to be the most likely to offer the highest increase in mine revenues per unit produced over the next decade. A major new bull market in silver could unfold.

Paul Sarnoff, eminent author of 27 books on metals trading, using some E & MJ figures, sees the immediate future about as follows:

Silver	**1983 est.**	**1990 proj.**
	(metric tons of silver)	
World Demand	17,000	37,320
World Supply	15,800	20,000
Shortfall	1,200	17,320

Where will the silver come from, he asks. (If his forecast proves anywhere near correct, the price of silver would increase quite substantially.)

SILVER FROM BASE METAL MINES

There is a worldwide excess of mining capacity. There is more than enough mining production capacity in copper, lead, nickel, zinc, tin and molybdenum to look after growth in consumption in those metals for the next 10 years, says the firm of Rowe and Pitman, London. Rio Tinto Zinc is reducing its dependence on metals other than gold. World demand for copper, zinc, lead and nickel will increase by only 1 to 2 per cent in the next 10 years.

An inexorable shift of the production and processing of all basic raw materials from the industrial countries to the Third World is perceived by some. The developing nations have two very great economic advantages: cheap labour and mineral reserves mineable at a very low overall cost. Metals mining, i.e. where it takes place, is a product of such forces.

In 1979, metals mining in the U.S. was a U.S. $8.9 billion operation, but by 1983 it had declined to $5.9 billion. Employment in U.S. mining had been 109,000 in 1981 and could fall a further 30 per cent in the next two or three years. The Bureau of Mines said the U.S. was in danger of losing 75 per cent of its copper industry.

The largest U.S. copper producers, Kennecott, Asarco and Phelps Dodge, were deep in the red again in 1984, with losses of tens of millions of dollars each.

The decline began in the 1970's when:

1) U.S., British and Belgian copper and other mines in Latin America and Africa were seized and nationalized.

2) Canadian and U.S. mining was hit with large extra capital costs for environmental equipment.

3) Many rich Canadian and U.S. base metal in-ground reserves are nearing depletion and much of the remaining low grade ore is becoming too expensive to mine. Most of the richest copper deposits are now in less developed countries.

4) Large new Third World mines opened up, financed by U.S., British, Canadian, French and German banks and the IMF etc., with excellent ore reserves, many of them being state-owned.

5) Price control of copper etc. by the major U.S. and British producers shifted to commodity exchanges, particularly the LME (London Metal Exchange).

6) The spot price of copper — about U.S. 56.40 cents a pound at the end of December, 1984 — is lower (in real, i.e. constant dollar terms) than at any time this century, except for the depths of the Depression in the 1930's.

7) Copper, in particular, is being eliminated from many end uses by substitutes such as glass fibre optics telecommunications cables, plastic pipes in homes, aluminum high tension power cables etc.

"The only thing worth developing now is a good grade precious metal deposit" said A. Powis, Chairman of Noranda, Canada. North American gold output is expected to escalate by 50 per cent by as early as 1989.

The total amount of silver coming out of the Western World's mines is being kept relatively low partly by the fact that the demand for base metals such as copper and lead continues to be so poor that mine output of the by-product silver is held down with them. Any contemplated mine expansions in developed countries may be constrained by very high interest rates and also, of course, by poor world demand for copper, lead, and zinc, with resulting low base metal prices.

GENERALLY SPEAKING, ONE DOES NOT MINE COPPER FOR THE SILVER BY-PRODUCT ALONE, NOR IS ANYONE GOING TO MINE A LEAD DEPOSIT JUST FOR THE SILVER CONTENT.

Silver is a secondary consideration to such mines.

The exceptions are developing countries like Chile, Peru, Zambia etc., which have been receiving large loans for mining from the World Bank and from a number of other banks, for expansions, all of which considerably worsens the position of established non-subsidized mines in Canada, U.S.A., Australia etc.

This limitation on base metal mine production in developed countries is therefore only slightly bullish for the price of silver.

Nevertheless gradual strengthening of the world silver price would be most welcome as it would, among other things, help to improve the earnings of many of Ontario's base metal mines, a number of which have important silver byproduct output.

The U.S.S.R. appears to be gradually becoming a net importer of copper as it is in the case of silver etc. The country has the world's third largest reserves of copper at an estimated 57 million metric tons. The largest copper deposit is at Dzhezkazgan in Kazakhstan and the other three major deposits are at Kounrad, Boshchekul and the Altai region in Kazakhstan. The Urals, Noril'sk and Uzbekistan are other sizeable sources.

Self-sufficiency in copper supplies must presumably be a national objective, avoiding net imports and in this possible increase in copper output, more by-product silver may be recovered. About 234,000 persons are already employed in the Soviet copper industry.

It can be argued that one should not look at the copper price solely in terms of the U.S. dollar since that may disguise its world-wide price movements.

While the March, 1985 copper futures contract on the New York Commodity Exchange fell from U.S. 78 cents in March, 1984 to 57 cents early in January, 1985 and cash copper fell from 56 cents to 42 cents in the same period, buying on the London Metal Exchange sent the copper price in early January, 1985 to its highest level since February, 1980, 1,196.25 pounds sterling per metric ton. The immediate ingredients for the rise were the steady fall in LME inventories in the previous few months and of course the continuing decline in the value of the pound sterling against the dollar in that period.

The picture of the decline of agricultural, oil and metal prices in U.S. dollars in 1984 should be seen against the broader backdrop of the gentle recovery in the major non-U.S. industrial countries.

COPPER'S FUTURE

World demand for refined copper in the year 2000 has been studied by various authorities. In summary, these give the following uninspiring picture:

DEMAND FOR COPPER IN 2000

(million short tons)

	Year 2000		
Study	**U.S.A.**	**Rest of World**	**World**
Newcomb, 1984	2.5	12.3	14.8
RFF, 1980	3.4	14.6	18.0
Malenbaum, 1977	3.5	15.0	18.6
MEP, Australia, 1979	2.9	15.7	18.6
U.S. Bureau of Mines, 1980	3.5	16.0	19.5
Leontief, 1982	3.7	20.2	23.9

Sources: Professor Richard Newcomb, Arizona Bureau of Geology and Mineral Technology, University of Arizona, Fall 1983 and Winter 1984

RFF, Resources for the Future, Johns Hopkins University Press, Baltimore, MD, 1980

Professor Malenbaum, U.S. National Science Foundation, 1977

MEP, Australian Mineral Economic Pty., 1979, Sydney

U.S. Bureau of Mines, Mineral Facts and Problems, 1980

W. Leontief et al., Institute of Economic Analysis, New York University, June, 1982

Erosion of copper's share of the market vis-a-vis competitive materials has accelerated in those applications considered vital, such as electrical, communications, transportation and construction and by the substitution of specific advanced technology utilizing aluminum, glass fibre, silicon chips, PVC tubing etc., instead of copper.

SHORT-TERM SUPPLY/DEMAND FORECAST — COPPER

('000 metric tons)

	1983 (Forecast)	1983 (Actual)	1984 (Forecast)
Mine production	6,250	6,214	6,200
Refined production	7,050	7,342	7,100
Refined consumption	6,900	6,759	7,100
Balance	+ 150	+ 583	—
East/West trade (net imports into West)	—	— 282	— 50
Government stockpiles	—	—	—
Balance	+ 150	+ 301	— 50

Source: Mining Annual Review

FORECAST WORLD SUPPLY OF COPPER IN THE YEAR 2000

SUPPLY (from Mines and Secondary Sources)

	(million short tons)		(million short tons)
North America (Canada and U.S.A.)	3.3	Western Europe	0.2
Latin America	4.2	Pacific Basin (Asia, Australia, New Zealand)	1.2
Africa	3.9	Total Forecast Supply	14.8
Eastern Europe, including U.S.S.R.	2.0	(See Demand — Newcomb)	

COPPER — MINE PRODUCTION

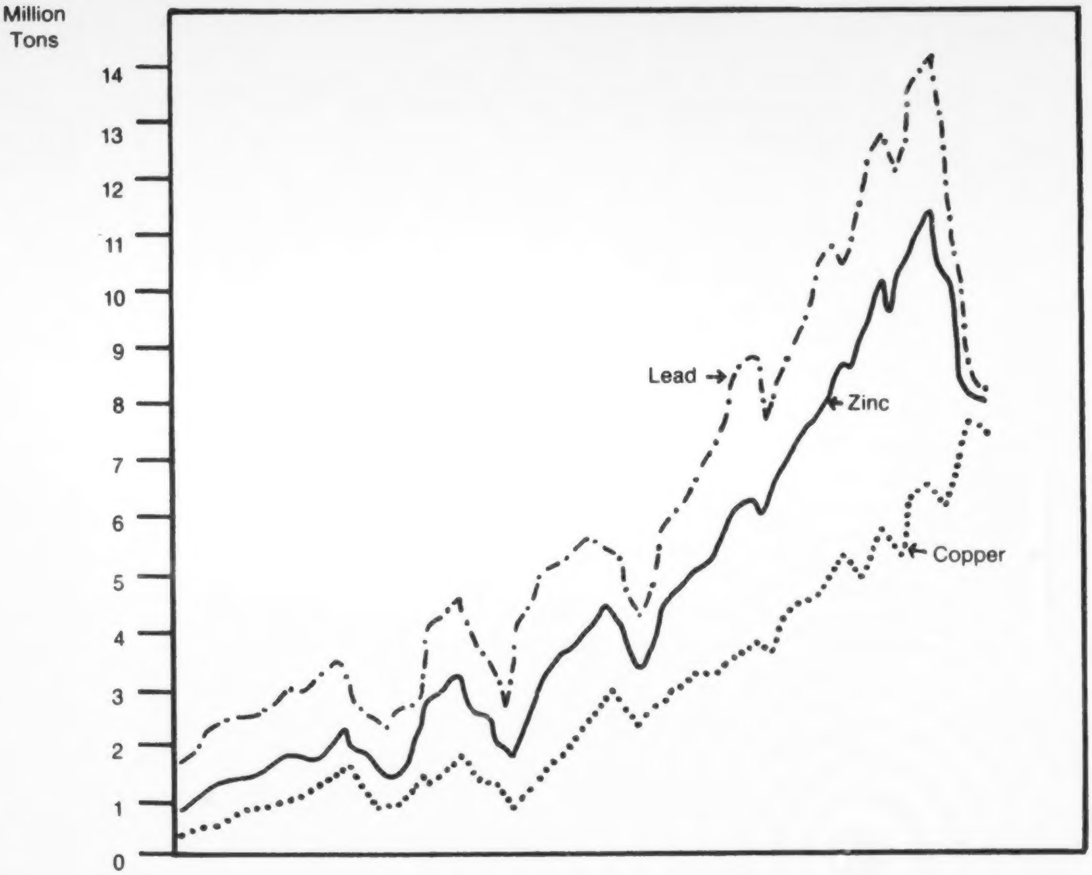
('000 metric tons)

	1981	1982	1983
Canada	691	612	615
U.S.A.	1,538	1,140	1,046
Chile	1,081	1,240	1,247
Mexico	230	239	193
Peru	328	356	317
Other America	18	27	42
Yugoslavia	111	119	110
Other Europe	184	186	197
South Africa	211	207	211
Zaire	505	503	503
Zambia (a)	587	581	570
Other Africa	95	113	116
Philippines	302	292	275
Other Asia	210	262	294
Australia	231	245	265
Papua New Guinea	165	170	183
Western World	6,487	6,292	6,194

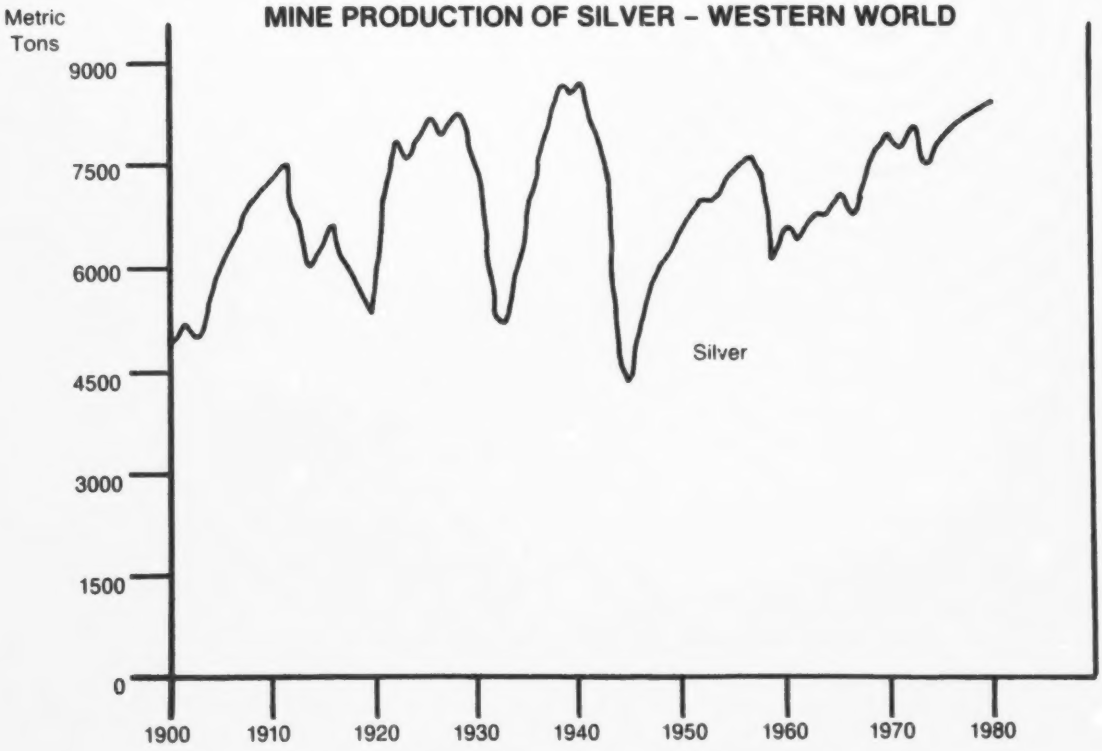
(a) WBMS estimates for 1982 and 1983 seemingly exclude Nchanga tailings leach output.

Sources: WBMS, RTZ, Mining Annual Review

MINE PRODUCTION OF ZINC, LEAD AND COPPER – WESTERN WORLD



MINE PRODUCTION OF SILVER – WESTERN WORLD



ACTUAL 1983 FREE WORLD COPPER MINE PRODUCTION AND ESTIMATED RELATIVE 1984 PRODUCTION COSTS

Country	Mine Production ('000 s.t.)	% of Western World	1984 Estimated Production (U.S. cents per lb.)
Chile	1,372.5	20.4	50
U.S.A.	1,152.7	17.1	72
CANADA	688.9	10.2	74*
Zambia	566.1	8.4	80
Zaire	553.9	8.2	70
New Guinea Australia	493.6	7.3	65
Europe	359.4	5.3	65
Peru	347.0	5.2	58
Phillipines	299.2	4.4	75
South Africa	226.0	3.4	60
Mexico	210.5	3.1	75
Other	470.2	7.0	80
TOTALS	6,740.0	100.0	68.7 (average)

*Even at 70-75 cents a pound, virtually no Canadian newly mined copper output appears profitable.

ASARCO COPPER PRODUCTION COST (U.S. CENTS CASH/LB COPPER)

	1981	First Half 1984	Reduction (%)
Mission Complex			
Mining, milling	53.2	36.6	31
By-product credit	-9.9	-5.5	
On-property cash cost	43.3	31.1	28
Smelting, refining, marketing	42.6	32.1	25
Total Net Cash Cost	85.9	63.2	26
Closed August 15, 1984			
Silver Bell mine*			
Mining, milling	51.3	41.6	19
By-product credit	-5.5	-1.3	
On-property cash cost	45.8	40.3	12
Smelting, refining marketing	42.9	31.6	
Total Net Cash Cost	88.7	71.9	19

***Closed** August 15, 1984

DEMAND FOR COPPER IN 2000 (TWO ESTIMATES)

(million short tons)

	Newcomb	Leontief
North America	2.8	4.1
Latin America	0.8	2.0
Africa	0.2	1.0
Eastern Europe, including U.S.S.R.	3.4	4.9
Western Europe	4.3	6.5
Pacific Basin (Asia, Australia, New Zealand)	3.3	5.4
Total Forecast World Demand for Copper	14.8	23.9
(Compare 1980 Actual	9.9)	

Source: Newcomb, 1983, 1984: Leontief, 1982.

Consumption of copper in industrial companies rose by an estimated 8 per cent in 1984, a year in which demand exceeded supply by about 300,000 metric tons. Copper consumption has been growing strongly in the U.S.

Early in 1984, a stock surplus of around 750,000 metric tons of copper remained unsold. Mine capacity of 900,000 metric tons of copper per year remained shut down. By December, 1984 London Metal Exchange stocks had fallen from 435,000 tons a year before to 133,000 tons of copper.

In 1982, Chile actually increased its copper output by 15 per cent, while the U.S. cut its production by 25 per cent and Canada by 11 per cent. In 1984, Chile produced 1.3 million metric tons of copper, OVERTAKING THE U.S.A. AS THE WORLD'S LARGEST PRODUCER.

The major handicaps affecting the mine producers in developed countries over the long term appear to include:

1) the rise in wage levels and other output costs;
2) the obsolescence of older smelters;
3) high levels of domestic taxation;
4) the depletion of high grade domestic ores;
5) government regulations on the environment.

About 10 per cent of the present annual copper production capacity outside the Soviet Bloc exceeds current requirements and will not be needed even at the peak of the next business cycle, according to CRU, but some new production will come on stream anyway in efforts to reduce output costs, worsening the overall picture.

The rationalization of the copper mining industry is still under way.

The 12 major U.S. mine producers of copper now employ only about 25,000 workers and the mines are running at only 60 per cent of capacity, even though U.S. copper consumption is already up 14 per cent over 1983. The average cost of U.S. mine output of copper is now 82 U.S. cents per pound, (September, 1984) which is much higher than the rest of the world.

Copper's cheapness in the next few years and its expected relative price stability could, you would think, be turned to distinct market advantage by producers, but there is little sign of that yet. Collectively, copper producers spend on market research and promotion an amount which is under U.S.$6 million equivalent.

ZINC — MINE OUTPUT

In 1983, Western world overall mine output of zinc declined slightly by 30,000 metric tons to 4.78 million metric tons, 0.6 per cent below 1982. Canadian output was down 10 per cent to 1.07 million metric tons, in spite of the new Polaris mine. U.S. mine output of zinc was down 8.5 per cent to 302,000 metric tons.

DEVELOPING FACTORS IMPACTING ON THE PRICE OF SILVER

There are at least forty factors impacting on the silver price daily, weekly, monthly or intermittently, each with different weight at different times. This helps to explain how easy it is to forecast the silver price.

REMEMBER, WE CAN NEVER COME UP WITH THE FUNDAMENTALS OF SILVER. THE DATA WE STUDY ON SUPPLY AND DEMAND AND STOCKS AND SO ON ARE ALWAYS UNSATISFACTORY, WITH FLAWS LARGE ENOUGH TO DISTORT OUR CONCLUSIONS.

BULLISH FACTORS FOR THE SILVER PRICE THAT MAY EMERGE

1. Shrinking overall world supply of silver with the continuing drawdown on surface stocks, but no hope of a large increase in mine output.
2. Scenario of mine production of silver at well below the level of consumption in industry and the arts is seen to be permanent.
3. A weakening U.S. dollar later in 1985, against a background of high budget deficits, which could lead to strong buying of precious metals. A weaker dollar would shift flight capital back into silver and perhaps gold. It would also alleviate, to some extent, the debt and interest problems of developing countries, (particularly Latin America). Troubled developing countries now owe major western banks and governments an enormous U.S. $800 billion. If this has to be written off, in whole or in part, a number of banks would fail. Many observers assume that these enormous debts and their interest costs will never be repaid. In other words, the whole thing will have been an unplanned Marshall Plan of outflowing dollars from the U.S. The mere threat of such a collapse would probably cause the silver price to shoot up. Silver price remains comparatively high in terms of non-U.S. major currencies.
4. A major Third World country defaults on its debt.
5. Lower interest rates — first half 1985 or later?
6. Revival of the rise in inflation; (about 4.2 per cent in 1983 and 1984 in the U.S., and no worse is expected by some in 1985). The Aden sisters and others say that the next wave of inflation will go to 20 per cent and maybe even 25 per cent. To be more conservative, if we see the return of inflation rates between 9 and 14 per cent, the silver price should quickly double. By early 1985, consumer prices may be rising at a rate of 8 or 9 per cent. Inflation may rise faster than interest rates by the first quarter of 1985, as has happened before. Between 1972 and 1974, the inflation rate went from 3 to 12 per cent; investment demand for silver greatly increased; the price of silver almost quadrupled. From 1976 to 1980, inflation went from 5 to about 12 per cent and the price of silver just about quintupled. The U.S. Congressional Budget Office predicts U.S. $190 billion deficits for each of the next few years. More money has to be printed to cover the deficits, thus increasing the "paper" money supply. Defence spending remains high and there is a reluctance to raise taxes. (This inflation problem is perhaps and the single most important factor in the investment or hedging demand for silver.) LIKE MARK TWAIN'S, THE OBITUARIES FOR INFLATION MAY BE PREMATURE. Silver will rise in price whenever there is an expectation that the rate of inflation will increase. But see note 13 under Bearish Factors which follow. The rate of inflation is likely to pick up when the U.S. dollar finally begins to fall and when commodity prices stop dropping.
7. Chairman of the U.S. Federal Reserve, (the U.S. central bank), increases the issue of U.S. paper money. Expansionary monetary policies in the major industrial countries.
8. Continuing upturn in the U.S. (and other Western?) economies.
9. Further purchases of silver from the West by the Soviet Union, combined with no significant exports of silver to the West by Poland or other satellites because of Soviet needs.

10. Large scale purchases of silver for national stockpiles.
11. Deterioration in U.S.-Soviet relations; political uncertainties and crises involving the super-powers.
12. Tensions close to full combat involving major nations in the Middle East etc. Sizeable military adventures usually affect silver and gold prices, pushing them up. Greatly increased U.S. involvement in Central America.
13. Strikes in North American and South American silver producing mines and transportation dislocations.
14. Increased hoarding of silver by individuals and companies. Increased purchases by the general public of the smaller silver bars and certain silver coins and of paper instruments directly covering physical holdings of silver and gold.
15. Silver has weakened against gold to about the 45:1 range, possibly indicating that silver is underpriced, (or that 45:1 to 60:1 is a new normal?). See Chapter 3.4. The average for the 1970's was 28.5 to 1.
16. Greater production of silver fuel cells for commercial use.
17. New high technology applications for silver and particularly specialized coinage issues in various countries.
18. Silver replaces gold etc. in many applications, (electronics etc.).
19. Finally, we have had many months of little movement in the silver price. A long dull period usually precedes bursts of great activity and price volatility and many analysts say that the next move will be in the upwards direction. Other analysts point downwards and talk of testing the trough of 1982.
20. A higher gold price.
21. Higher food prices are an index of higher rates of inflation and a reason for higher prices for silver, many traders believe. (That is why silver prices tend to go up when soya bean prices go up, although that does not appear logical to many people. Silver and soya beans are a bellwether for general food prices, which are closely linked to inflation. Traders often use silver as a hedge, buying it when soya bean prices rise and then selling it when soya prices begin to fall. See Bullish Factor number 3.) Many world commodity prices are so low, both in nominal and real (constant dollar) terms that the downside risk is almost nil, a great incentive to many investors.
22. A rise in scrap demand. Metal scrap demand always rises before a general economic upturn and metal scrap demand rose in 1984.

BEARISH FACTORS FOR THE SILVER PRICE THAT MAY EMERGE

1. Sales of silver, 155.5 metric tons, from the U.S. government stockpile are contemplated during the fiscal year, October 1, 1984 to September 30, 1985. President Reagan has authorized the sale of 310 metric tons for the coming year but the sales may not take place.
2. Release of all or part of the Hunt hoard of silver in the U.S.A., reportedly almost 2,000 tons. The Hunts must sell all their silver by 1990, under terms of the loan agreement with the banks. They cannot sell this stock without the consent of the independent bank which has been appointed trustee to oversee any such operation and make sure that other stringent conditions set by the Federal Reserve are adhered to.
3. Probability of new silver and gold sales from official government reserves in Latin American countries, such as Argentina, Peru, Bolivia, Brazil and Mexico. The external debt of many Third World countries — amounting to U.S. $800 billion — continues to hold up the growth of international borrowing.
4. Continuing build-up of surface stocks of silver metal at commodity exchanges etc.
5. A lower, more stable gold price in U.S. dollar terms.
6. a) Increases of major significance in world mine output of silver and/or
   b) If large new deposits of silver are found.

7. If the sagging recovery in the West weakens further. Weak oil prices and negative economic growth in OPEC countries. An economic environment less favourable to silver than in the 1970's.

8. Increase in Interest Rates? Rates kept higher than normal because of projections of future U.S. government deficits with high defence and welfare spending. High interest rates — in constant dollar terms — discourage investment in hedge assets such as the precious metals. High interest rates in the U.S. contribute directly to the strength of the U.S. dollar.

9. A strengthening U.S. dollar, i.e. failing to resume its decline. The 1984 U.S. Tax Reform Act would, in the short term, help to strengthen the U.S. dollar and make U.S. products more costly abroad and increase the foreign trade debt. The U.S. dollar has risen 40 per cent against other key currencies since 1980, say Morgan Guaranty Trust.

10. Uncertainty over the response to a stronger than expected economic growth by the U.S. Federal Reserve. It may tighten monetary policy, probably only in concert with suitable action regarding the U.S. budget.

11. New Soviet Bloc sales of gold to the West, usually caused by the frequent below-target grain harvests in the U.S.S.R., which normally pull both the gold and silver prices down. Upcoming sales of silver by the Soviets, (in spite of their chronic supply shortfall), were also rumoured in November, 1984. This would be bearish for the price. The Soviet Union will probably have to import in the winter and spring of 1984-85 about 50 million tons of grain worth U.S. $8 billion.

12. Reduced total demand for silver from the automotive and other industries.

13. Deflation or lower inflation in the industrial countries. This began to be perceived by some in Wall Street in July, 1984. Deflation causing lower gold, silver and other metal prices and lower prices for other commodity prices in the immediate future was a strong rumour in November, 1984. Most crystal balls put inflation for the rest of the 1980's at within a range of 3 to 6 per cent in the U.S.

14. Increased recycling with improved technology and/or a scrap recovery volume rise, using present methods only.

15. Increased substitution of silver by other materials.

16. Increase in dishoarding of silver in India, the Middle East or even in the Western World.

17. Other commodity markets outperforming silver and gold. Speculators find greater attractions in financial futures, currencies or soft commodities than the silver contracts traded on the exchanges.

18. Many people lost money on silver and gold trading between 1980 and 1984 — some bitten several times. It will take some time to get them back.

19. Perception that silver is not undervalued at U.S.$6 to $11 an ounce.

20. Perception that the supply of silver in the Western World from newly mined metal and various surface stocks will be more than sufficient to meet the demand for silver through the year 2000 and probably beyond.

FOREIGN EXCHANGE RATES – CANADA
U.S. DOLLARS PER CANADIAN DOLLAR

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
January	1.00867	1.00528	.99367	.98923	.90817	.84045	.85921	.83981	.83863	.81404	.80107
February	1.02387	.99946	1.00633	.97289	.89834	.83651	.86504	.83420	.82370	.81479	.80131
March	1.02881	.99971	1.01440	.95140	.88841	.85188	.85245	.83946	.81941	.81553	.78738
April	1.03384	.98904	1.01695	.95140	.87599	.87235	.84344	.83978	.81649	.81159	.78161
May	1.03935	.97263	1.02039	.95371	.89376	.86533	.85245	.83269	.81043	.81381	.77262
June	1.03477	.97432	1.02713	.94565	.89158	.85305	.86841	.83057	.78414	.81158	
July	1.02064	.97021	1.02864	.94251	.88928	.85951	.86812	.82546	.78747	.81142	
August	1.02450	.96591	1.01490	.93033	.87698	.85429	.86272	.81768	.80313	.81061	
September	1.01394	.97446	1.02568	.93175	.85742	.85820	.85865	.83285	.80993	.81142	
October	1.01733	.97562	1.02814	.91012	.84554	.85088	.85540	.83142	.81305	.81177	
November	1.01302	.98647	1.01448	.90152	.85269	.84772	.84314	.84218	.81552	.80859	
December	1.01205	.98636	.98163	.91139	.84784	.85501	.83557	.84380	.80763	.80202	
Yearly Average	1.02257	.98329	1.01436	.94099	.87717	.85377	.85538	.83416	.81079	.81143	

Source: Bank of Canada, monthly averages of daily (noon) U.S. spot rates.

3.4 SILVER/GOLD PRICE RATIO (OR BI-METALLIC RATIO)

In January, 1984 the gold/silver price ratio was about 45:1.

This existed in ancient times. In Egypt under Menes, about 3,500 B.C. it was 2.5 to 1. Around 2700 B.C. it was 1:9. Under Hammurapi in 1800 B.C. it was 1:6. By the 6th Century B.C. it was 1:12 and remained between that and 1:16 for centuries.

The 1792 U.S. Coinage Act set a Mint ratio between gold and silver of about 15 to 1, making silver then U.S.$1.29 an ounce.

Looking at the gold/silver price ratio over a fairly long period of time, the price of gold has generally been approximately thirty-two to thirty-five times the price of silver. In mid-1981 it was nearly 50:1. At the beginning of 1982, the price of gold was forty-seven times the price of silver, suggesting that silver may have been underpriced at that time. The gold/silver ratio stood at 51 to 1 at the end of April, 1982.

This silver/gold price ratio never completely disappears historically — only the figure changes. If, for example, gold succeeds in creeping up to U.S.$500 an ounce, then silver is capable of going to about U.S.$14.00, at a ratio of about 36 to 1, or to $10 at a ratio of 50 to 1.

The U.S.A. has always had a love affair with silver in its monetary status. Silver's price position relative to gold has improved over the last few years. The former U.S. Government official purchasing price for silver, fixed the range of the silver/gold price ratio for over 33 years, but in 1973, after six years of the free price, the ratio fluctuated between 45:1 and 30:1.

The fixed price for silver was abandoned in 1967 and for gold in 1968. On January 22, 1974, "nearby" silver traded on N.Y. Comex at a high of over $4.00 per ounce, for the first time. On February 21st, 1974, Handy and Harman's spot price for silver reached U.S.$6.67 an ounce and the gold/silver price ratio went to about 1:26, meaning that the silver price was over twice as strong as it was in 1934, relative to gold. However, the ratio went back to 1:34 in 1978. A 1:30 gold/silver price ratio would appear to some to be more "normal" than the 1:40 of mid-1980. See Chapter on Ancient Gold Sources — Gold/Silver Ratio. However, it may turn out that the new "normal" is 50:1 or more.

During the 1970's, gold sold for 28.5 times the price of silver. In November, 1980, the ratio was 1:34.

Certain market specialists figure that some 90 per cent of the fluctuations in the silver price can be explained by changes in the price of gold since 1968.

The correlation between gold and silver prices could become even closer, according to Credit Suisse, the eminent Swiss bank, although Shearson Lehman/American Express, London believe the opposite.

It is a surprising fact that during the last decade, it may be considered to be fairly certain that more people in North America have made money trading silver than those who have made money trading gold.

Silver's position relative to gold has improved substantially over the years. In 1973, the ratio fluctuated between 1:45 and 1:30. On January 11, 1974, nearby silver traded on N.Y. COMEX at a high of over $4.00 per ounce, for the first time. The gold/silver ratio is now about 1:45, meaning that the silver price is much stronger than it was in 1934, relative to gold.

The 1984 report of Shearson Lehman/American Express, London, predicted that

1) silver will gradually lose its status as a precious metal, although this could take years or even decades;
2) silver, traded only on the basis of its qualities as an industrial metal, is unlikely to repeat the spectacular price rises seen in the five years through 1980 and
3) the "theoretical" gold/silver price ratio will disappear.

While 2) is acceptable, 1) and 3) are extremely unlikely and against the historical trend.

THE OIL PRICE AND SILVER

The Silver Institute estimates that the oil price has maintained an equivalency with the silver price during 1974-1980 of about 0.5:1 (barrels: ounce). This points up the level of the prices of barrels of oil and gold in 1979-1980 with a gold:silver ratio of some 36:1. The current silver-gold monetary ratio is above the 40:1 level.

Oil prices have achieved an equivalency with gold of about 18:1 (barrels: ounce).

THE "GOLD PRICE" OF OIL

(Based on Annual Average Prices)

Year	Barrels of Oil per Ounce of Gold
1950	12 to 13
1970	14.11
1972	16.94
1974	13.67
1978	14.15
1979 (prices for week ending December 14)	18.65 to 20.00
1980	15.0 to 18.75
1981	22.0

Source: Metals Week

The gold price has been increasingly related to the price of a barrel of oil. At present prices of gold and oil, they move fairly well in parallel, reflecting in part the increased "cheapness" of the dollar expressed in gold or oil terms. It should not last and may disappear in the later 1980's, with gradually declining gold supplies and increasing oil availability. The oil price was still a bargain in the U.S.A. and Canada in mid-1979, expressed in terms of gold. The price of gold had risen from U.S.$35/ounce to $280, (an increase of over 700 per cent). Around 1946, the U.S. thought that its Gulf of Mexico oil was worth $2.68 a barrel. In July, 1979, the U.S. had to pay an average of about $20 a barrel, (or a 646 per cent increase).

OPEC's 1973 and subsequent oil price hikes and the 1979 revolution in Iran, the continuing 1980-85 Iraq/Iran War, the continuing 1979-85 Soviet invasion of Afghanistan, the China-Vietnam border problems, Poland etc., helped to push the gold market beyond $200 in 1978 and to $850 in 1980.

The 1981 gold/oil price ratio — based on Saudi crude — demonstrated that one troy ounce of gold bought 22 barrels of oil.

The weak oil market in 1984 cut the revenues of oil-producing states and therefore the main driving force in most of the economic activity in such countries — government spending — declined. Individuals in oil-rich countries had less money to spend on gold and silver and some even had to sell bullion to avoid going into debt.

The severe winter of early 1985 in the Northern Hemisphere helped to increase the overall demand for oil for heating but this should slacken off by April. The strong oil demand is said to have helped the gold price but, as winter disappears, that effect will probably fade. When viewed through European eyes, the oil price has been rising in their currencies as follows:

	January, 1980	Early January, 1985
	(per barrel)	
U.S. Dollar	37.00	28.10
West German D-mark	63.80	88.60
Japanese Yen	8,805	7,130
British Pound	16.35	24.50

Source: Economist

VALUE OF SILVER AND GOLD IN TERMS OF WORK DONE

Professor W.C. Lacy of James Cook University in Queensland, Australia has calculated the relationship between the selling prices of gold, together with silver, in constant terms and the number of days, (or hours), worked at the wages prevailing.

In 1966, the year before the silver price was freed and two years before the gold price was unfrozen, the constant dollar selling price for gold sank to the equivalent of 1 day's wages for one ounce, the all-time low. In 1980 it was equivalent to about 10 days' wages — the same as it had been in the early 1930's and around 1906.

Incidentally, silver's constant price all-time "low" was reached in the period from the early 1940's through the early 1960's, (when it was not free), at the equivalent of less than 1 hour's wages. It has not been 2 hours since 1913, but it almost got there in 1980.

His prediction for the future is that a reasonable long term price for gold that takes into account bulk low-grade deposits, the major source of future supply, with cut-off grades of 1 gram per metric ton and an assumed buyer resistance level, would be about 5 days' wages per ounce of gold, which he said would be around U.S.$350 per ounce under the inflation conditions of early 1981. The 1984 market price came close to that also.

A 1979 study in London indicated that the historic average gold price per ounce has been equivalent to half a month's wages. This, of course, is only to be taken as a rough guide because, inter alia, it depends on whose wages are considered and in what country, all affected by inflation since 1979.

THE SILVER/GOLD PRICE RATIO

Some advisors say that investors should

1) buy silver at or above the gold/silver price ratio at 31 to 1 and
2) sell silver at or below the ratio at 26 to 1, (if we ever see that figure again in the next few years).

ACLI expected that support for the ratio may surface between 38 and 40 to 1 for 1984 and the near future.

The average for the 1970's was 28.5 to 1. It was around 45 to 1 in mid-1984.

If its relative strength were to double the 1970's figure again, we might be quite close to the historical 15 or 16:1.

The end-1983 silver/gold price ratio was 43:1. On April 27, 1984, it was 41.52 to 1. Many analysts believe that the mean ratio of around 35:1 of the 1968 through 1983 period will re-appear in 1985, i.e. the silver price will climb faster than the gold price, but that appears to be too soon.

However, since mid-1983, the gold price has been stronger in the ratio than the silver price. Those who have studied the data, showing a dramatic increase in the release to market of various forms of scrap silver at each rung of the ladder as the price of silver rises, believe that this means that the ratio will go to 50 or 60 to 1 again by early 1987 and will stay there.

The current price is around U.S.$6.00 an ounce. Historically, the gold price pulls the silver price along, usually in a ratio of between 70:1 and 16:1, i.e. it takes somewhere between 70 ounces and 16 ounces of silver to buy one ounce of gold. At 70:1, $700 gold in 1988 would give a silver price of $10. At 16:1, the silver price then would be an exciting $43.75 an ounce. The strongest likelihood, some feel, is well above the recent historical average of 35:1, which would mean $14 silver at $700 gold, if the ratio were 50:1.

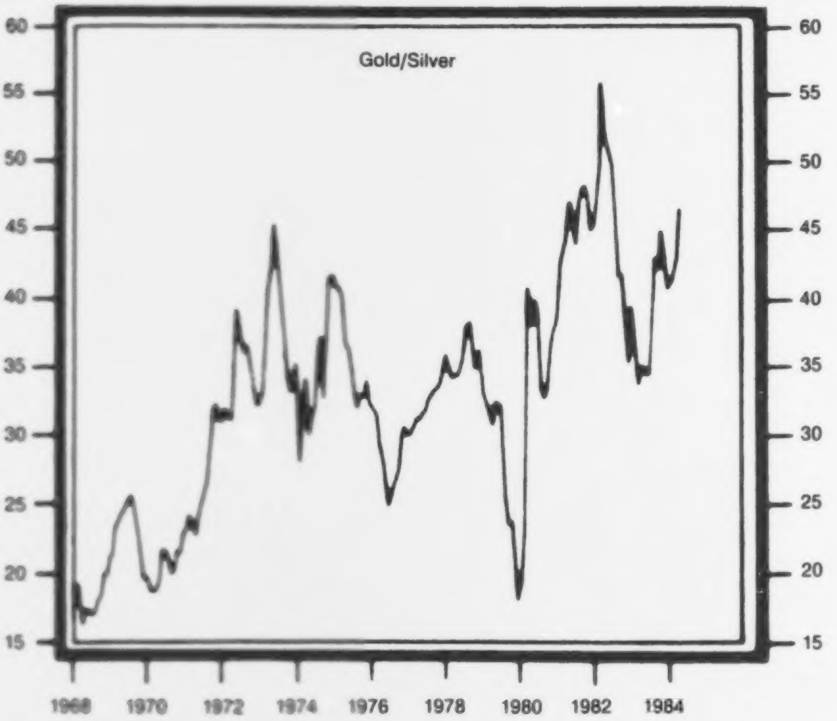
The eminent trader Paul Sarnoff says that when the ratio gets above 34 to 1, gold is too expensive in relation to silver — time to buy silver or spread by selling gold and buying silver. If the ratio drops below 27 to 1, then silver is too expensive in comparison to gold, he says.

If you look at the period from about the end of the Middle Ages to the late nineteenth century, silver held its value basically as well as gold did. If you had bought gold in 1493 at 11.3 times the silver price (1493-1520 average), then in 1875 your gold would have been worth the "classic" 16 times the silver price (1871-1875 average). Thus in up to 383 years, the gold-holder would achieve only a 41.59 per cent advantage over the silver-holder, a trifling return of 0.09% compounded annually! For nearly four centuries, a reasonably long test period, silver was essentially as good a store of value as gold.

The prime cause, of course, was the discovery following about 1860 of the Comstock Lode and other fabulously rich silver deposits in the U.S. and Canada. If you trace it through, the resulting enormous silver overhang was not worked off for a whole century until the U.S. government, which had heavily stockpiled the metal, got out of the business pretty completely. After an interval of a full century, which in historical terms is plainly an aberration, we are now back into free markets in both gold and silver.

While the price of silver has been rising very roughly in parallel with the rise in the gold price, the gold-over-silver multiple has frequently been over the 30-40 range attained during the glut years of the 1890's because again we have a surplus of silver supply over consumption. The gold-multiple could come in for a thumping drop down towards its historic range because the century-long force (sudden silver supply glut) which drove and held the gold-multiple up, has been changed. So silver has both a part to play in the gold price and also the gold-multiple.

MONTHLY PRICE RATIOS



Gold/silver ratio remains at historically high levels.

60 on the vertical scale indicates that it took 60 ounces of silver to buy one ounce of gold.

50 indicates that it took 50 ounces of silver to buy one ounce of gold, and so on.

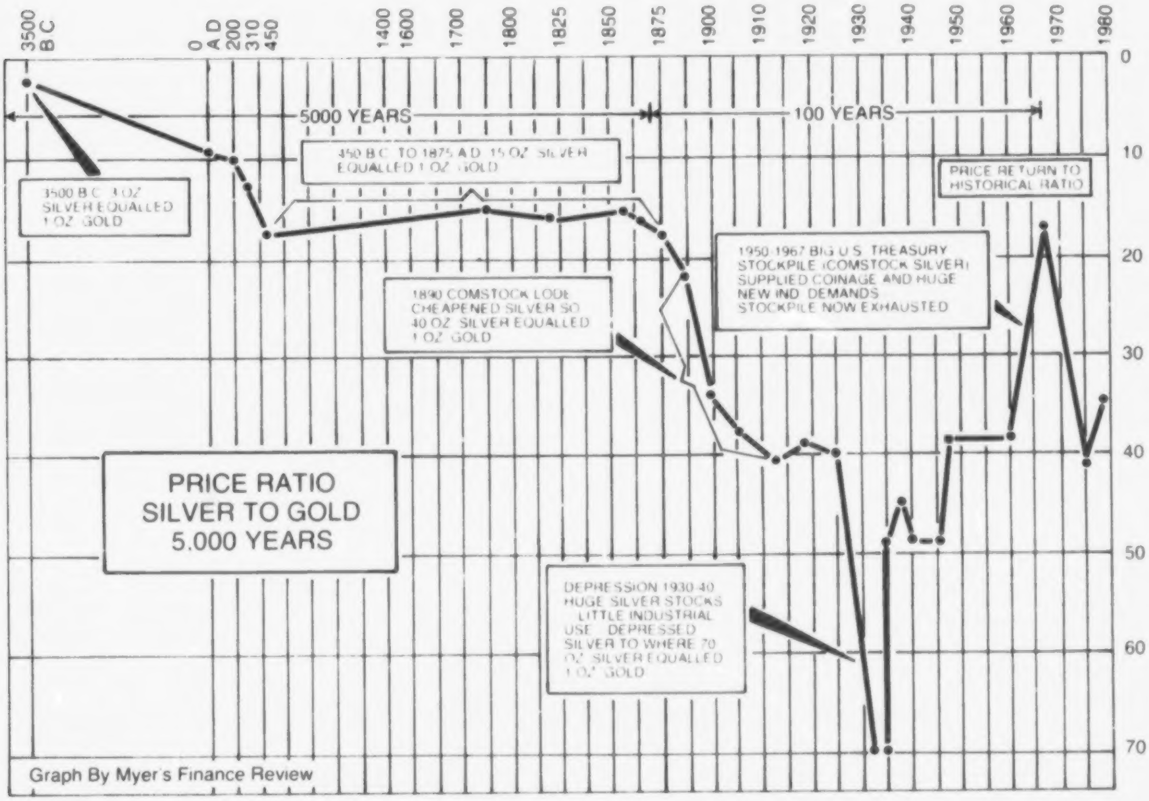
The steep rise and the limited fall in the price of silver over the last few years is illustrated as follows:

SILVER PRICES, 1975-82, ANNUAL AVERAGES

(per ounce 0.999 fine)

	London (pence)	New York (U.S. dollars)
1975	200.1	4.41
1976	242.4	4.35
1977	265.5	4.62
1978	282.4	5.40
1979	517.9	11.09
1980	900.8	20.63
1981	514.7	10.51
1982	455.4	7.92

Source: Samuel Montagu, Handy & Harman, EIU



PRICE RATIO
SILVER TO GOLD
5.000 YEARS

3500 B C 3 OZ
SILVER EQUALLED
1 OZ GOLD

450 B C TO 1875 A D 15 OZ SILVER
EQUALLED 1 OZ GOLD

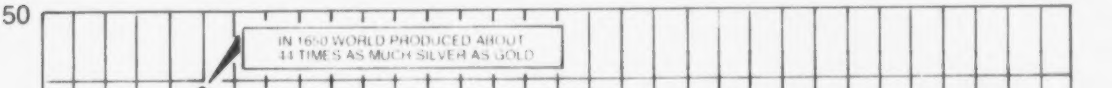
1890 COMSTOCK LODE
CHEAPENED SILVER SO
40 OZ SILVER EQUALLED
1 OZ GOLD

1950-1967 BIG U S TREASURY
STOCKPILE (COMSTOCK SILVER)
SUPPLIED COINAGE AND HUGE
NEW IND DEMANDS
STOCKPILE NOW EXHAUSTED

PRICE RETURN TO
HISTORICAL RATIO

DEPRESSION 1930-40
HUGE SILVER STOCKS
LITTLE INDUSTRIAL
USE DEPRESSED
SILVER TO WHERE 70
OZ SILVER EQUALLED
1 OZ GOLD

Graph By Myer's Finance Review



PRODUCTION RATIO
SILVER TO GOLD

IN 1650 WORLD PRODUCED ABOUT
44 TIMES AS MUCH SILVER AS GOLD

ADVENT OF SOUTH AFRICAN
GOLD REDUCED SILVER
RELATIVE TO GOLD

TO 1975 WORLD
PRODUCED 5.7
TIMES AS MUCH
SILVER AS GOLD

GREAT COMSTOCK LODE
INCREASED SILVER PRODUCTION
RELATIVE TO GOLD

ALMOST CONSTANT RATIO
BETWEEN GOLD AND SILVER
LAST 40 YEARS

Graph By Myer's Finance Review

VALUE RATIO OF SILVER TO GOLD (AND IRON) THROUGH THE AGES*

Year	Silver/Gold Value Ratio	Remarks, Authority, etc.**
Prior to 3500 B.C.	1 or less	No records known
c. 3500	2:5 or 3:1	In Egypt. Code of Menes.
3000	5:1	Near East and Mesopotamian cities of Ebla and Mari traded on a basic ratio of 5 ounces of silver to 1 ounce of gold. In the records of Mari itself, it was 4:1, (a higher value for silver).
3000 B.C.		The price of iron in the Bronze Age was 1 iron to 40 silver.
2700 B.C.	9:1	Middle East.
	8:1	Sargon of Akkad's time.
1800 B.C.	6:1	Babylon, under Hammurapi.
From 1670 B.C.	8.9 to 18:1	Middle East — range of the ratio in the years following.
708	13.5:1	In Assyria. Cuneiform inscription at Nineveh.
From 700 B.C.		The price of iron was 2,000 iron to 1 silver.
600	12:1	Greece. First Greek coins used. Ratio remained between 12:1 and 16:1 for the next few centuries except in China, where it was 6:1.
500	13:1	In Persia. 10:1 in Greece in the 5th Century. Herod III. Among the Hebrews, the gold shekel was tariffed to the silver shekel at a silver/gold ratio of 1:13.3. The 13 or 13.3 is the basis of "true value". The 10 measured the "denominational" (face value) worth of silver coins versus gold coins.
450	15:1	In Middle East and Europe. 15:1 with significant local exceptions.
400	12:1	In Greece. Plato.
404-336	12:1	In Greece, Peloponnesian war to time of Alexander.
334	10:1	In Greece. Fall in gold value due to influx of Alexander's spoil from Persia from 334 B.C.
218 and 206	10:1	In Rome. Silver/Gold Ratio fixed by law. Lasts until 84 B.C. Rome conquered Spain, which became its main source of silver and therefore wealth.
186	10:1	In Rome. Celts in Britain mint their own silver and gold coins.
84	9:1	In Rome. Lowered by Sulla.
58-49 B.C.	8.9:1	In Rome. Fall in gold value due to influx of Caesar's gold and silver spoil, from Gaul.
1-37 A.D.	10.9:1	In Rome. Reigns of Augustus and Tiberius. Roman conquest of silver-rich Celtic Britain begins slowly in 43 A.D. under Claudius.

VALUE RATIO OF SILVER TO GOLD (AND IRON) THROUGH THE AGES* (Continued)

Year	Silver/Gold Value Ratio	Remarks, Authority, etc.**	
54-68	11.8:1	In Rome. Reign of Nero.	
81-96	11.3:1	In Rome. Reign of Domitian. Roman Empire at its greatest geographical extent in 118. Beginning of the Decline of the Roman Empire in 180.	
312	14.4:1	In Byzantium. Reign of Constantine; Christianity tolerated.	
438	14.4:1	In Rome and Byzantium. Theodosian code. Rome quit Britain permanently.	
527	15:1	Byzantium.	
740-779		Value of silver doubles in England, in relation to gold. Britain had become Anglo-Saxon England. The Celts ruled in Scotland, Ireland and Wales.	
864	12:1	In Europe. Edictum Pistense.	
1344-1482	11.1:1	In England. Mint returns.	
1382-1492	12.1:1	In Europe.	
1492	11:1	In Europe. Discovery of the Caribbean islands and of Central America.	
1493-1520 average	11.3:1	In Europe.	
1497	10.7:1	In Spain. Discovery of Newfoundland (now part of Canada) by England's Bristol merchant venturers.	
1550	12:1	In Europe.	
1641	14:1	In Europe. Moran and John Locke on money.	
1690	16:1	In Europe. Sir Isaac Newton at the Royal Mint, London, fixes the price of gold in 1717, which remains for the next 200 years.	
1730	16:1	In Europe. Kelly's "Cambist".	
1760	14.3:1	In London. Del Mar	
1800	15.7:1	In Europe and U.S.A.	Napoleonic War continued.
1850	15.7:1	In Europe and U.S.A.	Discovery of the enormous silver "Comstock Lode" deposit in Nevada, 1859 and the "Great Bonanza" silver deposit, Nevada, 1873 increased the ratio against silver to 40:1 by 1890.
1886	22:1	In Europe and U.S.A.	Discovery of the vast Rand goldfield, South Africa.
1890	22.1:1	In Europe and U.S.A.	
1896			Klondike Gold Rush in the Yukon, Canada

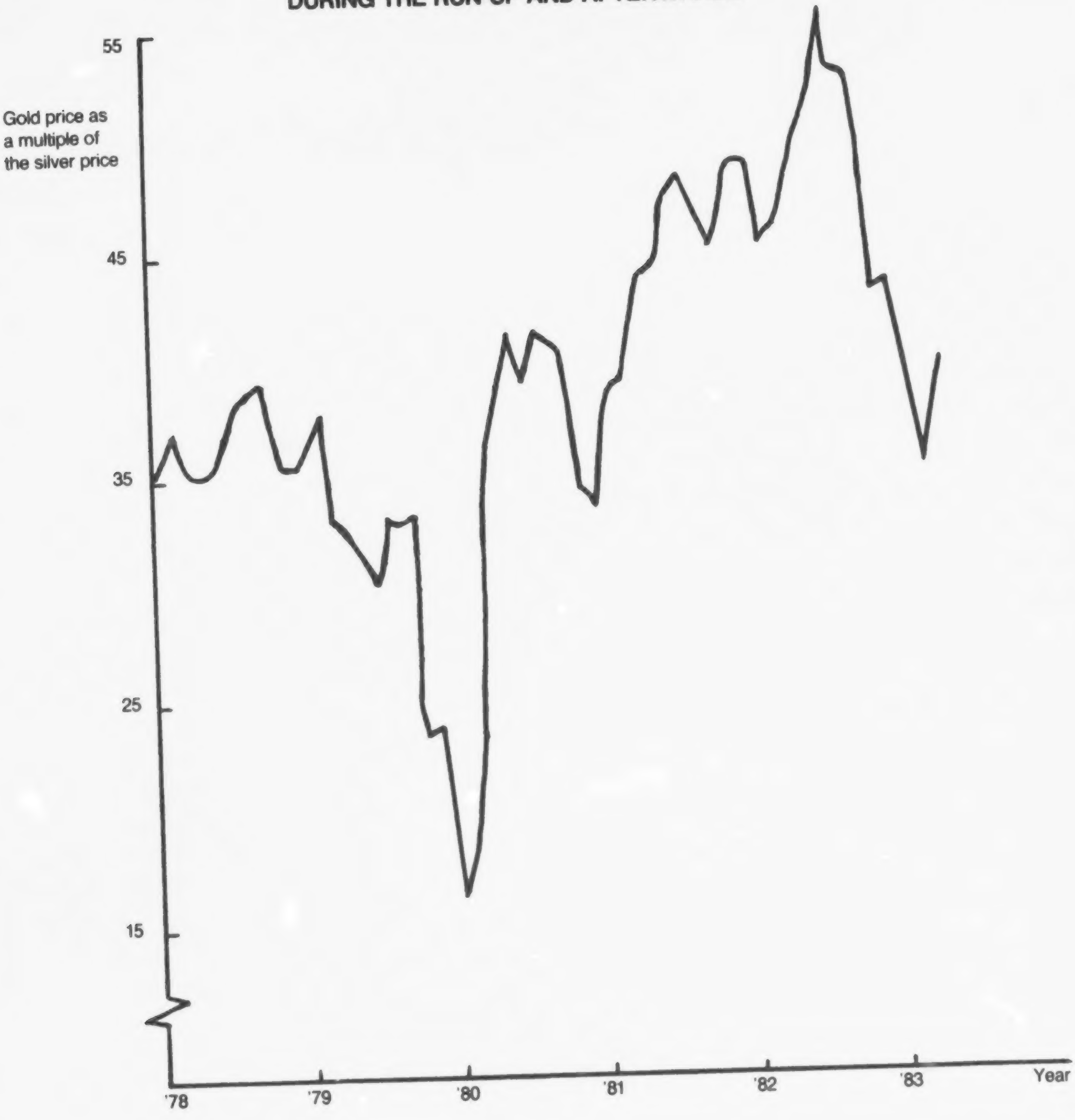
VALUE RATIO OF SILVER TO GOLD (AND IRON) THROUGH THE AGES* (Continued)

Year	Silver/Gold Value Ratio	Remarks, Authority, etc.**	
1900	34.4:1	In Europe and U.S.A.	Boer War for the gold mines continues. Cobalt, Ontario silver field discovered, 1903
1910	38.2:1	In Europe and U.S.A.	
1915	38.2:1	In Europe and U.S.A.	World War I.
1920	20.8:1	In Europe and U.S.A.	
1930-34	60.8 to 70:1	In Europe and U.S.A.	Depression world-wide
1935	45.5:1	In Europe and U.S.A.	Re-armament commences
1939	50:1 to 70:1	In Europe and U.S.A.	World War II.
1950	41.2:1	In Europe and U.S.A.	Korean War.
1960	38.5:1	In Europe and U.S.A.	
1967	15.1:1	World	Myer's Finance Review. The so-called historical silver/gold price ratio of about 15:1 returned. Free market in silver permitted. U.S. and Canada start to abandon silver coinage.
1968			Free market in gold permitted.
1970	21.1:1	In Europe and U.S.A.	Viet Nam War continued but withdrawal of U.S. troops begun.
1971			President Nixon shuts the gold window. The U.S. dollar no longer convertible to gold.
1975	41.9:1		In Europe and U.S.A. End of Viet Nam War. U.S. citizens permitted to own gold.

* The figures given are the calculated value ratios in the currency of the time and should all be read as follows: 2.5 indicates that at the stated time gold was two and a half times the value of silver; 12 that it was twelve times, and so on.

** T.P. Mohide; Sources of information also include various documents in the British Museum and British Library, London; National Museum, Athens, Greece; Vatican Library, Rome; Jacob (1831), Del Mar (1880) and the Geological Survey of Canada. The values since 1800 were obtained mainly from the Engineering and Mining Journal (EMJ) annual volumes. No attempt was made to authenticate all of the values shown, and no adjustments have been made to compensate for the differences between the various currencies of different countries.

GOLD/SILVER PRICE RATIO
DURING THE RUN-UP AND AFTERWARDS



ACTUAL MONTHLY GOLD/SILVER PRICE RATIOS DURING THE RUN-UP AND AFTER

Month	Ratio (%)
1978	
January	35.145
February	36.086
March	34.853
April	34.297
May	34.422
June	34.600
July	35.471
August	37.528
September	38.083
October	38.490
November	35.164
December	35.128
1979	
January	36.342
February	33.121
March	32.527
April	31.895
May	30.890
June	32.691
July	32.231
August	32.424
September	25.561
October	23.339
November	23.583
December	21.247
1980	
January	17.653
February	19.066
March	22.940
April	35.637
May	41.005
June	38.210
July	40.056
1980	
August	39.472
September	33.546
October	32.720
November	33.380
December	36.251
1981	
January	37.785
February	38.445
March	40.427
April	43.248
May	44.232
June	46.073
July	47.430
August	46.035
September	44.251
October	47.247
November	48.404
December	48.417
1982	
January	47.854
February	45.244
March	45.677
April	48.012
May	50.114
June	56.439
July	52.328
August	51.773
September	49.891
October	44.413
November	42.023
December	42.276
1983	
January	39.056
February	35.129
March	39.592

(Monthly average, in per cent)

3.5 SILVER – CURRENT INFLUENCE OF THE GOLD PRICE

One should not discuss the silver price without careful consideration of the gold price situation. Factors affecting gold prices are many and complicated, such as primary and secondary supply, stockpiling by Central Banks, interest rates, industrial and speculative demand, OPEC's role in the world's economy, geo-political occurences such as a Russian wheat crop failure, Middle East wars and the success or failure of major western world countries' battles with inflation and recession, as well as the strength of the U.S. dollar.

Broadly speaking, expectations of economic or political uncertainty, increasing inflation or civil unrest all tend to drive up the demand for gold. Expectations of economic and political normalization tend to drive down the demand for gold. Gold bears no interest and the costs of transactions involving gold are high.

The gold price movements are not the same in every country. Although the U.S. dollar price of gold fell by about 12 per cent during 1983, its value in many major currencies, (excluding Japan and Switzerland), remained stable.

Silver prices have been more volatile than gold's since 1975 and have influenced the gold-silver price ratio more than gold, according to the respected R. Pittman and F. Katrak of Charles River Associates, adding that the ratio is more likely to rise above 35 to 1 or even to 50 to 1 than it is to fall significantly below 35 to 1.

Some analysts however estimate that up to 90 per cent of the oscillations in the silver price are caused by changes in the price of gold.

Assessments of experts on the future price of gold, taking into account all the foregoing influences mentioned, result in predictions by about 1985 ranging anywhere between U.S.$250 per ounce and over $3,000 per ounce. All the predictions are of course related to major considerations such as

1) a South African newly mined gold production fall-off from 1987, while
2) inflation is not controlled.

The gold price rose from U.S.$130 per ounce at the end of 1976 to $850 in January 1980, averaging $612 during 1980. In 1981 the price averaged $459 and is presently between U.S.$340 and $380 per ounce, having rarely moved above this range for about a year.

If control of inflation in the U.S. economy can be maintained over the next few years, the price of gold (which was relatively high in real terms throughout most of 1980 and 1981) can be expected to drop back to follow long-term trends. In particular, should the value of the U.S. dollar stabilize or should gold play an increasingly important monetary role, the price of gold could fall, resulting in a price range of probably about or below the $300 to $350 range in 1984 U.S. dollar terms.

If western inflation, primarily U.S. inflation, is brought under control, a long slide from present values for gold may be expected in real terms.

If, on the other hand, attempts to control governmental budgets in the west should fail, the gold price may very well resume a steep climbing trend, boosting the silver price.

The gold mining industry has been adjusting to a free market situation after a period of over-expansion due to the establishment in 1934 of a fixed — which was then a very high — price of $35 per ounce for gold. The stimulating effect of this is better understood when it is noted that $35 was then equivalent in purchasing power to about $185 per ounce in 1976 dollars or $115 per ounce in constant 1971 dollars. During the period between the end of World War II and 1971, inflation reduced the revenue per ounce from $85 to $35 in 1971 dollars.

Most Ontario gold mines benefitted for about 20 years up to 1976 from the now defunct Canadian Federal Emergency Gold Mining Assistance Act and from generous special provisions in the Ontario Mining Tax Act benefitting among others, gold and silver mines, which still continue. However, the freeing of the gold price from the fixed $35 per ounce in 1968 effectively resulted in no federal assistance to most mines after about that time because the gold price climbed and gold sold on the free market yielded greater returns.

Gold and silver will remain for the mine operator a more reliable cash crop than any other metals, and this will remain particularly significant for the smaller entrepreneur. As far as the major Ontario producers are concerned, shifts to high volume, capital intensive extraction methods on ore bodies grading well below 0.2 ounces per ton can, by and large, only be considered if gold prices soon recover to U.S.$500 or even the U.S.$600 per ounce level.

3.6 ABBREVIATED LIST OF INFLUENCES ON AVAILABILITY AND PRICES OF SILVER, GOLD AND OTHER PRECIOUS METALS IN THE LAST 200 YEARS OR SO IN THEIR HISTORICAL SETTING

It will be seen that a great variety of events impacted at the time or eventually, on the availability, production, demand and prices of *silver* and other precious metals during these two centuries. Today, apparently unrelated events such as the Polish situation, the oil glut, Soviet grain output levels, the Iran-Iraq War etc. all play their part in affecting the *silver* price.

Silver's long history shows that it gains value in periods of social unrest, of wars and of inflation. Not only does it consistently gain value but it holds on to its value or purchasing power over the long haul. Certainly, this has been dramatically shown once again, particularly during the history of the last two centuries.

Year	
1757-61	British support (subsidies) for Prussia against France provided by Pitt, who said "CANADA WILL BE WON IN SILESIA."
1759-60	Britain conquered Quebec, New France. The Marquis de Vaudreuil and the French Army surrendered Montreal and the whole of Canada to Great Britain.
1763	Ontario, then a virgin wilderness, became British, following the British conquest of French Canada in 1759-60. It later became a very important *silver* and gold producer. The end of France as a North American power.
1772	First year of issue of the particular "Spanish" milled *silver* dollar, (minted in America's oldest Mint in Mexico City), which became the model for the U.S. *silver* dollar of 1794 and in turn the Canadian *silver* dollar. It contained 27.07 g. of .903 fine silver. The Spanish *silver* dollar remained legal tender in the U.S., alongside the U.S. *silver* dollar, until 1857, 63 years after the first U.S. dollar was issued.
1774	Britain recognized *gold* as legal and common tender but France continued to back *silver*. A monetary price for *gold* had been set by Sir Isaac Newton at the British Mint in 1717 at 113 grains of *gold* to the pound sterling, which lasted about 200 years. (1 Troy ounce equals 480 grains). The Quebec Act passed. Ontario part of the British Province of Quebec, the southern boundary of which reached as far south as the Ohio river. The English break away from the shores of Hudson's Bay, founding Cumberland House well to the west in Saskatchewan ("rapid river"), Canada. The American colonies were prohibited from printing paper money and the shortage of "hard" coinage in gold and *silver* contributed directly to the onset of revolution.
1775	Paul Revere, *silver*smith and goldsmith, in an April 18 midnight ride from Charleston to Lexington warned of British troops approaching from Boston. American revolutionaries invaded Canada, captured Montreal November 13 and attacked Quebec City.
1776	The American revolutionary army withdraws from Canada in June after failure to hold Montreal or seize Quebec City from British forces under Guy Carleton, the de facto "Father of British Canada", who was born in Ireland in 1724. U.S. formal Declaration of Independence.

1778 Cadiz was the monopoly port for Spanish *silver* bullion fleets from Mexico, Peru etc. until this year. France signed treaty of aid with the 13 British colonies in revolt and renounced designs on Canada which the U.S. hoped would become the 14th State.

1780 First year of issue of the Maria Theresa Austrian *silver* dollar, (thaler) which has been minted continuously ever since in the hundreds of millions, (with the original date on them), for use in the Middle East by the vast numbers of people in those areas who still do not trust paper money and still use the *silver* thaler. A barrel of flour to feed Washington's army cost 1,575 continental paper dollars.

1781 The French naval blockade and the landing of 3,000 French and Irish troops under Rochambeau to join Washington at Yorktown. As the situation was hopeless, the British commander, Cornwallis, sent his second in command, Brigadier-General O'Hara to make the formal surrender to Washington's appointee. The war was effectively over. The majority of Rochambeau's force of 2,200 men in America were of the Irish Brigade of the French Army and its leader, Count Arthur Dillon with Dillon's Regiment was Rochambeau's second-in-command. Walsh and Walsh's Regiment were included and Irish Brigade officers included O'Brien, Roche, Murphy etc. One dollar in "hard" money (gold or *silver* coins) was worth $400 to $1,000 in paper money, in the U.S. R. Morris, head of U.S. finance, succeeded in getting a loan (in *gold*) of $200,000, brought over by the French navy, putting the U.S. on a "hard" money basis before the war ended in 1783.

1783 General Sir Guy Carleton, (later Lord Dorchester), evacuates thousands of Loyalists from New York by sea to Canada, the British having recognized U.S. independence. The British army quit U.S. territory.

Thousands of American colonists loyal to the King took refuge to what is now Ontario, New Brunswick and Nova Scotia, Canada (the "Loyalists", or Tories to the revolutionists), probably totalling 40,000 at that time. Britain gave the Loyalists liberal grants of land and cash compensation of almost 4 million dollars.

1784 Official date of the settlement of English-speaking people in what is now the Province of Ontario. Elizabeth II, Queen of Canada, visited the Ontario capital, Toronto, Ontario in September, 1984 to celebrate the 200th anniversary of the loyal Province and the 150th anniversary of the founding of the city of Toronto.

1785 The *silver* dollar and the decimal system of coinage adopted by the Continental Congress. Not brought into use until 1794.

1788 First British settlement in *silver*-rich Australia which grew rapidly, with convicts at first, but later the population comprised a higher percentage of Irish than any other country outside Ireland. (The U.S. Revolution had caused the end of the use of the American colonies as a dumping ground for British convicts).

1789 French Revolution. George Washington inaugurated in Wall Street, New York as the first U.S. President.

1790 The 13 Colonies (the U.S.A.) comprised 4 million English-speaking people.

1791 Canada divided into Upper Canada (now called Ontario) and Lower Canada (Quebec). Upper Canada (Ontario), now with its own legislature, promptly adopts English law. John Barber of England patented a gas-turbine engine utilizing heated, expanding gases. A turbine is a vaned wheel spun by an impinging stream of gas or liquid. Material able to take the high continuous heat evolved was not available until the 20th century — for jet engines etc., in which *silver* brazing is vital.

1792	Spanish and Austrian *silver* dollars were the model for the new U.S. *silver* dollar coin of 416 grains of standard *silver* alloy (then equal to 24.75 grains of gold), authorized by the U.S. Coinage Act which introduced the bimetallic — *silver* and gold — standard for its currency). Hamilton convinced Congress to make the alloy 90 per cent *silver* with 10 per cent copper, rather than 92.5:7.25, so the coins would wear better. Thus the U.S. dollar contained 0.77 ounce of *silver*, rather than the 0.8 ounce of the Spanish and Austrian coins. If one dollar contains 0.77 ounce, the price of the *silver* is $1.29 an ounce. Dividing the price of gold then, $20.67 since 1703, by $1.29 gives a price ratio of about 16:1. (The U.S. Treasury selling price for *silver* was $1.29 as late as 1967, (175 years later), when the *silver* price was set free.) The purchasing power of $1.29 in 1792 is about U.S. $15.50 today. However, the Spanish *silver* dollar remained legal tender in the U.S. until 1857, i.e. for another two-thirds of a century. That is only 128 years ago. U.S. Mint established. A special issue of 1,500 *silver* half-dimes was struck in July from *silver* deposited personally by President Washington. It is said that Martha Washington's *silver* table service was the source of the *silver* that went into the first U.S. coins.
1793	Britain declares war on France.
1794	First U.S. *silver* dollar minted.
1795	James Hutton, 1726-97, of Scotland published his "Theory of the Earth", which helped to pave the way to modern geological science, which has enabled many *silver* discoveries to be made.
1796	Gold scarce in Britain. Great Panic. French invasion of Ireland in December fails.
1797	Bank of England first issues paper pound notes. (They were no longer issued from December 31, 1984). Sir James Hall, Scottish geologist, physicist and chemist, founded experimental geology and chemistry. Great Panic. Bank of England suspends payment in Specie, (gold and *silver* coins). 1,200 French troops landed at Fishguard, Wales, the last foreign land invasion of the island of Britain.
1798	Irish emigration to U.S. and Canada escalates after the failure of the 1798 Insurrection of the United Irishmen.
1799	World mine production of *silver* averaged 870 metric tons per annum, compared to about 350 tons per annum in the early 1700's.
1800	Peru had 728 *silver* mines active and had a *silver* economy.
1801	An 1801 U.S. *silver* dollar was sold recently for U.S. $525,000. Population of London was only 959,000. In the 100 years from 1701, the population of England and Wales had risen to 9 million from 5.5 million, Ireland to 4 million from 1.5 million and Scotland to 1.65 million from 1 million. 9 million is only a fraction more than the present population of the Province of Ontario, Canada.
1802	Thomas Wedgwood's experiments in England with *silver* nitrate on paper and leather, reported to the Royal Institution of London, outlined that *silver* chloride is more sensitive in the photo effect. This was a vital discovery in the long procession of experiments by various people that have led directly to modern photography, the major modern use of *silver*. The first modern refining process to separate out the *gold* from *silver* from *silver*-bearing ores was developed by D'Arcet. Hugh Miller, Scottish geologist and author born; died 1856.
1803	W. Hyde Wollaston discovered the metal palladium and Smithson Tennant in England discovered iridium, the fourth and fifth of the 8 precious metals. On the

	proposal to use gas lighting in British cities, Wollaston said: "They might as well try to light London with a slice from the moon". Robert Emmett's rebellion in Ireland in July.
1804	W. Hyde Wollaston discovered the metal rhodium and Smithson Tennant discovered osmium. This meant that 7 of the 8 precious metals had now been discovered. U.S. Mint suspended the issuance of *silver* dollars and gold eagles. In those days, most U.S. *silver* dollars went to the West Indies where they were at par value with the heavier Spanish *silver* "pieces of eight". The Spanish coins went back to the U.S. Mint for recoinage into U.S. dollars that in turn went back to the West Indies, continuing the cycle.
1805	British under Nelson defeat French and Spanish fleets at Trafalgar.
1806	San Francisco was a Russian fur-trading post.
1807	Geological Society of London founded. Active war begins in Spain.
1808	The French occupied Madrid, Spain in March.
1809-14	The English and French Rothschilds, with great cunning and sophistication, smuggled through the French lines in Spain very large and critically vital sums of English money and *gold* and *silver* bullion to pay the expenses of Irish General Wellington's British Army there fighting Napoleon for five years. In one year alone, Nathan Rothschild of London secretly transmitted, through his brother James of Paris, 11 million pounds sterling in Continental subsidies and remittances, to Wellington's army. Nathan and his brothers did not want to conduct this smuggling business entirely by IOU's and notes but preferred to get "hard money", (*silver* and gold coins and bullion), to Wellington in Spain, sometimes in the floors of stagecoaches. Young James frequently dressed as a woman. Nathan had purchased 800,000 pounds worth of gold from the East India Company to start the process. Wellington expelled the French from Spain by 1814, ending, it seemed, the 21-year old war.
1810	U.S. population 7,239,881. Great Panic.
1811-1812	The *gold* reserves of the British banks prevented the collapse of the price structure, following the first anti-industrial riots by machine breakers, or Luddites. The first practical steam engine, used to pump water from mine shafts in Devon and Cornwall, had been invented by Newcomen a century before and had been improved by Watt in 1775 for use in the new "factories" of the world's first Industrial Revolution. War against Napoleon continued.
1812-13	Napoleon's armies destroyed by the Tsar's army and the harsh weather in retreat from Russia. Only 30,000 survived out of 500,000. U.S. declared war on Britain June 18, effectively supporting the French, invaded Canada and in April 1813, burned down York, (now called Toronto, Ontario) and also Newark (Niagara-on-the-Lake), Ontario. U.S. invasion failed. Canada, with its great mineral wealth, including *silver* and gold, remained British. British took Fort Niagara, New York and burned the village of Buffalo, New York.
1813	In the Battle of Crysler's Farm, eastern Ontario, Colonel Morrison led his 89th Irish Regiment and the survivors of Sir Isaac Brock's 49th in the defeat of a greatly superior American force. This victory prevented the capture of Montreal by the U.S., saved all of Upper Canada (Ontario) from being cut off from British supplies and reinforcements and saved Canada from being cut in two. Last gold guinea coins issued in England. They had first been coined in 1662. see 1817. Napoleon defeated

	by 200,000 Prussians, Austrians and Russians under Austrian General Schwartzenberg at Leipzig.
1813-1851	The purchasing power of *silver* was to increase by 69 per cent.
1814	British burned down the White House and other public buildings in Washington, D.C., partly in retaliation for the burning of York (Toronto) and Newark (Niagara-on-the-Lake) in Ontario, Canada. U.S. specie (gold and *silver* coins) payments suspended. Wellington defeats the French in Spain. Napoleon had abdicated April 6. Allies occupied Paris and France. British-American War ended on Christmas Eve, the U.S. and U.K. agreeing to create four boundary commissions to settle the border between Canada and the U.S.
1815	Wellington and G.L. von Blucher, the Prussian, defeat Napoleon at Waterloo through the efforts of the British Guards, the Household Cavalry and the Prussians. Napoleon abdicates for the last time. Establishment of stratigraphic geology for dating geological formations by self-taught Englishman W. Smith, ("Strata" Smith), 1789-1839. Miner's safety lamp invented by Sir Humphry Davy, 1778-1829, of Penzance, Cornwall, England.
1816	British adopted *gold* as the basis of its monetary system and the expression "*gold* standard" was first used. British paper pound sterling was redeemable in gold on demand. *Silver* coinage continued but this was the year of the very last minting of the British *silver* penny, (three years after the *gold* guinea was discontinued). The *silver* penny had been withdrawn once before, in 1662. Britain was the supreme economic and military power in the world in 1816. 40 years of peace and relative prosperity began, the Pax Britannica.
	As an outgrowth of the French occupation of Spain, through 1814, a number of *silver*-producing Spanish colonies in Latin America prepared to break away from Spain.
	Argentina independent from Spain. Its name is based on the Latin word for *silver*. The great river there is called Rio de la Plata. The Spanish word for *silver is plata*. The river's name and the country's came when Sebastian Cabot of England in 1526 sent a quantity of *silver* ornaments obtained from Indians there, to Spain. Argentina is still an important mine source of *silver*.
1817	The sovereign gold coin was reintroduced in England in 1817 under King George III. U.S. specie (gold and *silver* coins) payments resumed.
1818	*Silver*-rich Chile finally independent under B. O'Higgins, the Liberator of that nation.
1819	The U.S.A. was still effectively on a *silver* standard for money, however the law read. See 1849.
1820	The U.S. government had by now paid off most of its foreign debts in "hard" (gold and *silver*) currency. Altai, Siberia, alluvial deposits of gold exploited. Rich deposits of platinum discovered in the Russian Urals.
1820-30	George IV's expenditure on *silver* was prodigious and much of it is still in use by the Royal Family.
1821	*Silver*-rich Peru independent from Spain, followed by Guatemala, Panama and *silver*-rich Santo Domingo (Dominican Republic). Revolution in *silver*-rich Mexico. Populations of certain major *silver* producing and consuming countries were:

U.S.A.	9.6 million
France	30.4 million
Germany	26.0 million
Britain without Ireland	16.0 million
Ireland	5.8 million
Italy	18.0 million
Austria	12.0 million
Canada	well below 1 million

1822	J. Nicephore Niepce, 1765-1833, of France produced the world's first permanent photograph on an asphaltic or bitumen base. It took 8 hours of exposure. Metals-rich Brazil independent from Portugal.
1823	*Silver*-rich Mexico becomes an independent republic. The last Spanish Governor of Mexico was J. O'Donoghue (spelled O'Donoju in Spanish).
1825	*Silver*-rich Upper Peru renamed Bolivia and declared an independent republic. See 1821.
1826-37	Cholera pandemic killed millions in continental Europe — about 900,000 in 1831 alone. Niepce made a photograph on a glass plate and on metal.
1827	Statement of the law of electric conduction, "Ohm's Law", by Ohm of Germany. *Silver*'s thermal and electrical conductivity is greater than any other metal.
1828	Blast furnace invented by J.B. Neilson, Scotland. Russia issued the world's first solid platinum coins.
1829	J.N. Niepce, his son and Louis J.M. Daguerre join forces on solid *silver* plate and *silver* iodide photography experiments. Lena river, Siberia, gold placer deposits first exploited.
1830	U.S. debt repudiation; depression.
1830-33	Sir Charles Lyell's "Principles of Geology", in 3 volumes, published. One of the great books of the world.
1831	U.S. population 12.8 million.
1833	The Factory Act in England soon led to Mine Inspectors. Government inspection was to grow significantly in many countries. Slavery abolished in the British Empire, including Canada and the maritime colonies (now Provinces), three decades before most of the U.S. Compensation to owners 20 million pounds sterling.
1834	Technical adjustment in the U.S. *gold* price to U.S.$20.67; (this U.S. price was not abandoned until 1934, 100 years later). The U.S. Act established a coinage ratio of 16 to 1 between *silver and gold*, (with the result that *silver* was driven out of the U.S.A.). City of Toronto, Ontario incorporated.
1835	*Photography* on paper — what we now call a negative — developed by W.H. Fox Talbot of England using *silver* chloride. (thus the single largest future industrial use of *silver* begins to be developed). Talbot's process was the first stage in the central mainstream of photographic development, leading to today. The inventions of Niepce and Daguerre proved to be merely bypaths. Extinction of United States National Debt. Justus von Liebig discovered the process of "*silvering*" — the formation of a *silver* or other metallic coating on glass to give it the properties of a mirror. Put into practice in 1840.

1836 Electroplating developed by Warren de la Rue, England. Electroplated *silver* tableware became a very popular mass production item later in the century. Great Trek of Boers, (Dutch-speaking white settlers), north across the Orange river out of British South African territory into what was to be a fabulously rich precious metals producing area, now the world's single largest source of gold and of the metal element platinum and a sizeable source of *silver*. The term catalyst coined.

1837 Golding Bird described electrodeposition of *silver*. Gold price set at U.S.$20.67. Commencement of Panic in London. Discounts refused. U.S. specie (gold and *silver* coins) payments suspended. Many houses trading with the United States stop payment. Accession of the young Queen Victoria. First Canadian railroad. Rebellions in Ontario and Quebec in Canada. Population of Upper Canada, i.e. Ontario, 350,000.

1838 Resumption of Specie (precious metal gold and *silver* coins) payments in United States. British-Afghan War. Afghanistan was an ancient *silver* producer.

1839 English Crisis. Banks in United States again suspend payments in Specie. *Photography* — further developments published by Daguerre of France with the photograph being permanently produced on an iodised *silver* metal plate. See 1835. The fuel cell was first discovered by Sir William Grove, using platinum electrodes.

1840 Canadian population: 1 million. Union Act gives *Canada*, (then Ontario plus Quebec), responsible government. Liebig process to make *silvered* mirrors put into practice. See 1835 and 1880. Yenisei Ridge *gold* deposits started output in Russia. By 1840, a high proportion of the British troops in India were Irish.

1840-62 Cholera pandemic world-wide killed millions.

1841 Populations:

Ontario	0.455 million
Quebec	0.625 million
U.S.A. (an increase of 7.4 million in 20 years	17 million
Britain without Ireland	18.5 million
Ireland	8.5 million

1842 Upper (Ontario) and Lower Canada (Quebec) united under one parliament. Forces of *silver*-rich Afghanistan surrender to British/India army, ending the Afghan War, but 16,500 British and Indian troops and servants were massacred during the return to India. See 1880, 1838.

1843 Treaty of Commerce opens *silver*-hungry China to all Nations.

1845 Ruthenium, recognized as an element by C.E. Claus of Esthonia, was first isolated by the Polish chemist J. Sniadecki. This completed the discovery of the 8 precious metals. U.S. annexes Texas from Mexico.

1846-48 U.S.-Mexico War.

1846 First discovery of *silver* in Ontario, Canada, at Prince's mine, east of Port Arthur, Thunder Bay. See 1866 and 1873. Commercial and Railway Panic. Repeal of the English Corn Laws because of the worsening famine in Ireland. This steadied prices generally.

1846-54 Over one million Irish people died of starvation and disease caused by the famine resulting from potato blight which came from America. More than 1.5 million Irish survivors of the famine emigrated during the years after 1846, mostly to the U.S.A. and Canada. Quite a number of them found *silver* there and one found the richest gold area in Australia later in the century. See 1859, 1873. There are now about 55 million Americans of Irish or part-Irish descent and possibly 4 million in Canada. Two men of Irish origin are running the U.S.A. and Canada today, President Reagan and Brian Mulroney, Prime Minister.

1847 Year of Panic. 10 million pounds sterling granted by Britain for relief of the terrible Famine in Ireland. Gold discovered in Mexican province of Upper (i.e. Northern) California, leading to the first Gold Rush, (the "49-ers").

1848 U.S.A. makes great territorial gains from Mexico; Mexico cedes gold-rich California and New Mexico to the U.S.A. Gold was discovered in Alaska (when it was Russian territory, i.e. Russian America) by engineer R.P. Doroshin, in the Kenai river. Sir William Logan noted a nickel occurrence in Ontario at the West end of Lake Ontario, in Ontario.

1849 Canada's right to control her own affairs fully recognized by Britain. In spite of the bimetallic, (*gold* and *silver*) requirements of the 1792 Act, the first U.S. *gold* dollars were not coined until this year, 1849, well over half a century after the Act. *Silver* coins had virtually disappeared from circulation in the U.S. by this year.

U.K. issues a new coin, a *silver* florin or two-shilling piece, i.e. one tenth of a pound sterling, in the first move to decimalize the currency. The second and final move came in 1970.

1801-1850 Average world output of gold: 23.7 metric tons per annum.

1850 From about this date, the Mexico-minted "Spanish" *silver* dollar became the principal currency of the Yangtze valley and the main Chinese ports. Annual gold supplies had increased ten-fold between 1800 and 1850. World population 1.1 billion, estimated. Population of Ireland fell to 5.5 million from over 8 million only five years before. Consequently, fewer *silver* coins were needed there. U.S. population 23 million, including 3.2 million black slaves.

1850-60 The population of *silver*-rich Australia more than doubled in 10 years.

1851 The purchasing power of *silver* had increased 69 per cent since 1813. Scott Archer, an English architect, published his wet collodion process in *silver* iodide photography — still in use, it is believed, in some photo-mechanical establishments. Collodion is a complex nitrate chemical used in wet-plate photography. When mixed with light-sensitive *silver* salts it can form a colloid — a mixture in which tiny individual crystals of the *silver* salts remain evenly dispersed, allowing an even distribution of the light-sensitive crystals over the glass plate. Discovery of gold in Australia in Victoria and New South Wales.

1851-1853 California *gold* inflation. The gold discoveries in California and Australia raised prices generally and ushered in a great period of expanding trade.

1851-73 U.S. *silver* 3-cent pieces issued.

1852 First *gold* rush in British Columbia. Niagara Falls suspension bridge open.

1853 *Silver* coins reappeared in circulation in the U.S. after their intrinsic value had been reduced.

1854 Russian (Crimean) War began; U.K., France, Turkey invade southern Russia. W.T. Mulvaney, Irish industrialist, went to the German Ruhr valley and organized the opening of coal mines and iron works there, including some still called "Hibernia", "Shamrock" etc. He organized the Bergbauverein, (association of Ruhr industrialists), the largest such European complex, the basis of future German industrial power. Germany is now one of the world's leading *silver* consumers and the leader in Western Europe. Britain maintained her political dominion over Canada by sanctioning a partial economic union with the U.S. in a reciprocity treaty. See 1866.

1855-1860 Australia the world's largest mine producer of gold, exceeding that of the U.S.A.

1856 Russian Crimean War ends as the Allies withdraw from the Tsar's territory.

1857 Spanish *silver* dollar ceases to be legal tender in the U.S.A. Panic of 1857. U.S. specie (gold and *silver* coins) payments suspended. See 1849. Specie payments resumed later.

1858 Canada, (then Ontario plus Quebec), issued *silver* 5-cent and 10-cent coins minted in England in a new decimal currency, modelled on the U.S. coins, replacing shillings and pence. The Royal Canadian Mint in Ottawa, Ontario would open in 1908. Shillings still survive in Austria (schillings) and East Africa. Ottawa, Ontario, becomes the capital of Canada.

1859 One of the most fabulously rich deposits of precious metals found in the world, the phenomenal "Comstock Lode" *silver-gold* discovery in Nevada, made the U.S.A. the world's largest *silver* producer. Impoverished Irish miners who had found the precious metals near Virginia City sold their claims to a Harry Comstock, partner of Peter O'Riley and Patrick McLaughlin. The goldminers cursed the "black stuff" (argentite) that made recovery of the gold difficult, but when it was assayed it turned out to be *silver* of incredible richness. The Comstock mine flooded the world market with *silver*. It eventually produced a total of over 15,550 metric tons of *silver*. See 1873. Comstock was the origin of the fabulous Hearst fortune. First practical storage battery developed by R.L.G. Plante; batteries would eventually consume large quantities of *silver*.

1860 U.S. Crisis. 914,000 people emigrated from Ireland to the U.S. and Canada during the decade 1851 to 1860.

1861 U.S. Civil War begins, the North, 22 million people, against the South, 9 million; U.S. *specie* (*silver* and *gold*) coins payments suspended. Nevada with its large output of *silver* remained loyal to the Northern cause, boosting the North's economy and greatly helping the North to finance the war. Canadian natural products enjoyed extensive trade with the increased demand caused by the war.

1862 Runaway inflation — to last 4 years — causes Congress in the U.S. to authorize paper Federal debt notes in $5 and $10 denominations and declare them "legal tender". Dynamite invented by A.B. Nobel.

1863 Large U.K. exports of *Gold* to the Continent to pay for *Silver*. Henry Clifton Sorby, 1826-1908, discovers the microstructure of steel and so leads to the development of the science of *metallurgy*. He also discovered a method of making thin sections of rock suitable for the microscope. President Lincoln declared slaves free forever.

1864 13 million pounds sterling of *Silver* exported from France. Union of what are now three maritime Provinces of Canada proposed. Canada, (then Ontario with Quebec), suggested that it join also. See 1867.

1865 The U.S. South surrenders April 9 and Civil War ends. President Lincoln assassinated April 15. The U.S. Continental paper dollar worth virtually nothing, because of war-time inflation.

1866-1867 First sizeable discovery of *silver* in Ontario, Canada. Vein located at Thunder Bay, Ontario with a predominant content of *silver.*

1866-1868 Russia subjugated the Muslim Bokhara Khanate, (where a number of *silver* mines ànd the two largest Soviet *gold*-producing mines are now operating); area now called Uzbekistan and Kazakhstan, Soviet Central Asia. Tashkent, Uzbekistan, becomes the centre of Russian expansion in *gold-* and *silver*-rich Muslim Central Asia. British-Russian rivalry intensified. Irish-American Fenians' first invasion of Canada at Fort Erie, Ontario, opposite Buffalo, NY, 1866, failed; second Fenian attempt at Vermont-Quebec border in 1870 also failed. The first raid helped to accelerate Canadian Confederation in 1867. The U.S.-Canada reciprocity treaty of 1854 not renewed, because of a rise in U.S. protectionism.

1867 Dominion of *Canada* established July 1 as a confederation or federal union of the British Colonies, from Ontario to the Atlantic, to be called Provinces in the Irish fashion, following the U.S. government's "withdrawal of free trade" with these small British colonies north of the eastern U.S.A. The Canada Confederation was mainly the product of three forces:

1) the rise of Canadian nationalism;
2) a desire of British liberals to get rid of colonial responsibilities and
3) the ambition of certain elements in the U.S. to annex Canada.

After the French, the second largest ethnic group in Canada was the Irish, as distinct from the English, the Scots, the Germans, the Welsh, etc. (Incidentally, about 80 per cent of Canada's trade with the U.S. will again be duty-free by 1987, because of international commitments).

In Canada, Confederation in 1867 and the purchase of the enormous "Rupert's Land" area from the Hudson's Bay Company in 1869 frustrated the hopes of many U.S. citizens who dreamed of a continent-wide American empire, including (eastern) Canada, particularly when followed by the extension of Canada westward by the incorporation of Manitoba, 1870 and of British Columbia on the Pacific coast in 1871 into the Confederation of Canada.

Shuniah/Duncan mine found in Ontario, with some quite rich *silver* ore.

Russia sold the large territory of Alaska (later a *gold* producer) to the U.S.A. for $7.2 million, 2 cents an acre — a measure directed against Britain re Canada. Amur river system *gold* output started in Russia. Emperor Maximilian of Mexico assassinated. Great decline in U.K. Export of *Silver;* only 2.5 million pounds sterling sent from France. *Gold* discovered in Wyoming. Diamonds discovered in South Africa (These diamond mines later funded some large *gold-silver* mines in the Rand; the industries are still somewhat interlocked).

1868 *Silver* in metallic form (native silver) in very rich concentrations found on tiny *Silver* Islet island in Ontario (no larger than a good-sized ballroom) in Lake Superior. Thomas D'Arcy McGee, a "Father of Confederation", shot in Canada's first political assassination.

Treasure hoard of *silver* objects found at Hildesheim, Hanover, Germany is one of the most remarkable collections known from the ancient world. It dates from the 1st century A.D.

1869 "Black Friday" financial panic in New York caused by the attempt by Gould and Fisk to corner the *gold* market, September 24. Red River or Riel Rebellion in

Canada. Canada purchases the vast *North West Territories,* "Rupert's Land", the huge area of land draining into Hudson's Bay, (later an important *gold* and *silver* producer), from the 200-year old British Hudson's Bay Company, (HBC) *part of which later became Northern Ontario.* HBC was affectionately known as "Here Before Christ." Another part of the west, governed separately by the HBC, originally known as New Caledonia, was modern *silver*-rich mainland British Columbia. See 1878. Completion of the first U.S. transcontinental railroad, built mainly by Chinese and Irish labour. See 1885. Gold again found in Alaska, this time by the Americans. See 1848.

1870 Canada issued *silver* 25-cent and *silver* 50-cent coins. See 1858. The Breck or Silver Harbour *silver* mine discovered in Ontario. Manitoba becomes a Province of Canada. Invasion of France by Prussia. Panics. Russian Far East *gold* and *silver* deposits worked.

1870-1871 Second South African diamond rush; the large Kimberley diamond mine discovered.

1871 German Empire established under Kaiser Wilhelm I. 8.5 million pounds sterling of *Gold* exported to Hanse Towns. Peace between France and Germany. Mineral-rich *British Columbia,* later to become Canada's largest *silver* producer, joins Canada. Britain annexes Kimberley diamond fields in South Africa.

1871-1896 Sir Oliver Mowat, Prime Minister of Ontario, vigorously supported the rights of the Provinces vis-a-vis the federal government in Ottawa. These efforts established that, within their established constitutional rights, the Provinces are supreme and not under the supervision of Ottawa and they can alter their own constitutions.

1871-1900 U.S.A. the largest mine producer of *silver* during this period.

1872 8.05 million pounds sterling of Gold exported from U.K. to Hanse Towns. Commencement of decline in price of *Silver.* See 1896. Denmark, Norway and Sweden suspend free coinage of *silver.*

1873 Enormously rich deposits of *silver,* the "Great Bonanza", discovered in Nevada by William O'Brien, born 1826, J.W. MacKay, G.G. Fair and J.C. Flood, the four "Bonanza *Silver* Kings". O'Brien, MacKay and Flood were born in Ireland. O'Brien's descendants, married to the Newhalls, today comprise a socially impeccable family in San Francisco. The widow and son of J. MacKay, 1831-1902, presented "The Mackay School of Mines" to the University of Nevada as a memorial to him. Mackay mining graduates are prominent in the U.S. today. 21 million dollars worth of *silver* were taken from the Comstock in 1873. See 1859.

Canada's creation of the armed para-military federal Northwest Mounted Police, (now Royal Canadian Mounted Police), with cavalry training, living in barracks, modelled on the armed Royal Irish Constabulary, saved the country from the lawlessness of the mining camps in the Western U.S.A. See 1909.

U.S. financial panic of 1873. U.S.A. and the Netherlands demonetize *silver;* U.S. effectively de facto on a *gold* standard. U.S., *gold* dollar coins become the unit of currency.

Vienna Crash. 10 million pounds sterling of Gold exported from U.K. to Hanse Towns. German Imperial central Government announces the demonetization of *Silver;* adopts the mark as its currency unit, a *silver* coin based on gold reserves. The large quantity of the *Silver* and Gold coinage of the many formerly independent German principalities starts to be melted down and refined to pure *silver* and pure gold. Colour photographs first developed.

Depression in Canada was to last 20 years.

1874 Enormous increase of bullion in the Bank of France — mostly gold, some *silver.*

Gold discovered in the Black Hills of South Dakota, U.S.A. Vast new influx of white prospectors etc. Resolute resistance by the Dakota-Sioux. (Largest U.S. gold mine, Homestake, is still producing there). See 1876.

1875 Large Export of Gold to Germany. Continued decline in price of *Silver.* Gold found in the De Kaap valley in the Transvaal Republic, South Africa. For over 2,300 years through 1875, about 15 troy ounces of *silver* had been worth 1 ounce of gold in Europe and later, America, too.

The paper "greenbacks" of the U.S. currency of the Civil War period were fiat money (irredeemable money) but in 1875 were made redeemable against *silver* or gold.

1876 France and Belgium suspend free coinage of *silver.* Remarkable fluctuations in the rates of Exchange in India and in Bar *Silver. Silver* discovered in the Barrier Ranges of western New South Wales, Australia. Nickel ore found in French New Caledonia in the Pacific, east of Australia. New Caledonia, incidentally, was the original name of mainland British Columbia, Canada. Sioux annihilate troops under Colonel George Custer in Montana — the last large scale success of the North American Indians. See 1874. Indian leaders fled to Canada and therefore *silver*-rich territory, Idaho, Montana etc., became available for exploration and development in the U.S.A.

1877 *Gold*-rich Transvaal annexed to British Empire.

1878 British government conveyed to Canada all of British North America, except Newfoundland. See 1869. Peak output of the Comstock deposit in Nevada at 36 million dollars worth of *silver* in 1878, ($21 million in 1873). Bland-Allison (*Silver*) Purchase Act enacted in U.S.A. for the "free" coinage of *silver.* The *silver* dollar was 412½ grains. Gold discovered at Lake of the Woods, Ontario. Second British-Afghan War, 1878-1880.

1879 U.S. returns to a gold standard and *specie* (*gold* and *silver* coins) payments are resumed. Zulu war against Britain in mineral-rich South Africa. General (later the Earl) Roberts occupied Kabul, capital of *Silver*-rich Afghanistan.

1880 Gold and *silver*-rich Transvaal declared a republic. The Comstock *silver* boom in Nevada ends. General Roberts leads 10,000 men to relieve Kandahar and defeats the Afghans. See 1838, 1842. Silver had depreciated in price to $1.11, from $1.27 in 1874.

1881 Meeting of Conference in Paris respecting Bi-metallism, (*silver* and gold backing of currency), adjourned without coming to any practical conclusion. Canadian Pacific Railway (CP Rail) founded. Colour photography developed by F.E. Ives, U.S.A. See 1873. Independence of gold-rich Transvaal recognized by Britain.

1883 Discovery of *Silver* at Broken Hill, New South Wales and *nickel* at Sudbury, Ontario, Canada, (eventually the world's largest nickel source and an important producer of by-product *silver*). Canadian *silver* and other coins were so plentiful in the large cities of the northern USA as to amount to a nuisance and New York city specifically excluded them.

1884 Rich *silver* ore, later called *Silver* Mountain, discovered in McIntyre Township, Ontario. The *Silver* Islet mine in Ontario, on a tiny rock in Lake Superior, closed. It had produced $3.5 million (in the more valuable dollars of those days) in its 16-year life — Ontario's first sizeable *silver* mine.

Discovery of *silver* at Coeur d'Alene in Idaho — which still leads the states in *silver* output after a century of *silver* production. Russians capture the *silver*-rich region of Merv.

1885 Suspension of the Coinage of the Bland *silver* Dollar recommended by the President of the United States. Broken Hill Proprietary *Silver* Mines opened in Australia.

Second Riel Rebellion in Canada in March. Railway utilized by troops, although incomplete at that time between the north shore of Lake Superior and Winnipeg, an area now almost completely in Ontario. Rebellion over by May.

Canadian transcontinental CP railroad completed November 7th to British Columbia on the Pacific Ocean from Montreal and Ontario. It led to discovery of the major *silver* deposits in SE British Columbia of Cominco Ltd, a CP subsidiary, Canada's third largest mine source of *silver* today.

1886 *Gold* discovered in almost unbelievable quantities in the Transvaal in the Witwatersrand, (Rand). The Rand declared a *gold* field. Johannesburg founded. The arrival of the very large amounts of South African gold on the markets reduced the *silver* output ratio to gold. *Gold* found at Fortymile, Alaska, U.S.A. (The discoveries in California, Canada, Alaska, Russia, Australia and South Africa increased the world *gold* supply massively.)

1887 A double florin, a *silver* 4-shilling piece, was issued in England, but was discontinued in 1890. Discovery by MacArthur and the Forrest brothers in Scotland of the cyanide process for the extraction of *gold.* It remains the standard chemical method of recovering gold and *silver.*

1888 Rabbit Mountain, Beaver, Porcupine, Badger and Silver Creek *silver* mines discovered in Ontario. The highest world production ratio, silver to gold, between 1837 and 1984 was reached in this year, i.e. output was 19 times as much silver as gold. Kodak camera developed by G. Eastman, U.S.A. Mass market for *silver*-based photographic film eventually opens up with this camera. Deaths of two German Emperors successively caused great uneasiness. War rumours subsided later. Stringency of Money earlier than usual towards close of the year.

1889 Coinage of *Silver* unusually large.

1890 Serious financial panics in London and New York. The large *silver* output of the Nevada lodes had cheapened *silver* so that 40 ounces of *silver* equalled in value one ounce of gold. Political *silver* agitation commences in the U.S. Extension of *Silver* Legislation in the United States — the pro-silver Sherman *Silver* Purchase Act increased the monthly purchase and coinage of *silver* by 125 per cent. U.S. flooded with *silver* dollars. Boom in silver mining in the Western U.S.A. Mining of *silver, gold,* copper, nickel, zinc, lead, coal etc. in Canada valued at $9.4 million.

1891 Failure of United States legislation to maintain *silver* prices. The resulting surplus *silver* inevitably poured into China and India. See 1850. Colour photography developed by Gabriel Lippman, France, who received the 1908 Nobel Prize for Physics. Cyanide process in gold refining introduced. See 1887.

1892 Further depression in *Silver.*

1893 Discovery of *Gold* by Irishman Patrick Hannan at Coolgardie and Kalgoorlie in Western Australia. Mints in India closed to Free Coinage of *Silver* owing to rapid inflation. See 1891. Panic following repeal of the Sherman *Silver* Purchase Act in the U.S.A., which had had the effect of forming an "endless chain" for conveying *gold* to

Europe, much of it for the Far East. The new paper U.S. Treasury notes were displacing *silver* coins in circulation — Gresham's Law. See Appendix III. 20 year depression in Canada ends.

1894 The Montreal Star Almanac of 1895 said it was found convenient to continue the old (Spanish) dollar-mark ($) in the South and to adopt it in the North.

Duty of 5 per cent imposed on *Silver* entering India. War between China and Japan. A piece of *silver* weighing about a ton was taken from the Smuggler mine at Aspen, Colorado.

1895 Wilhelm Konrad Roentgen of Germany discovered X-rays. Film negatives of X-rays used in medicine and industry are now a major user of *silver*. U.S. currency difficulties.

1896 Defeat of the *Silver* party in the U.S. Election. The *silver* crusade collapsed a few years later when the extraction of *gold* from low grade ores began. Extensive Coinage of *Silver* by Russia. Price of *silver* had fallen to half its 1872 level. Mining of *silver* in North America suffered. Klondike placer gold rush begins in the Yukon, Canada at Bonanza Creek.

1898 Border dispute between Ontario and Manitoba was decided by the Privy Council in favour of *Ontario*. It had delayed the opening up of *gold* development in the Lake of the Woods and Seine river areas, now in Ontario. Spanish-American War.

1899 World mine production of *silver* averaged 5,000 metric tons a year. Boer War in South Africa begins October 10 — a struggle to control the *gold* mines. 30,000 persons in *gold* rush in the Klondike, Yukon Territory, Canada. Dawson, Yukon, a mining centre, had the largest population of any North American city north of San Francisco and west of Winnipeg.

1900 World mine production of *silver* was 5,404 metric tons. Annual *gold* supplies doubled between 1850 and 1900, during which time more gold was mined than was mined in all of man's history before 1850. See 1850. Repeal of the free coinage of *silver* in the U.S. U.S. on Gold Standard de jure (rejecting *silver*). Prospector James L. Butler discovered *silver* in Nevada at Tonopah and Goldfield. The four "*silver*" states were Idaho, Colorado, Nevada and Montana. Continuation of the Boer War for the *gold* mines with Roberts Commander-in-Chief and Kitchener Chief of Staff, both later Colonels of the Irish Guards regiment of the Royal Household. Large Coinage of *Silver* Rupees for India. German Crisis.

1900-1968 Mexico again the world's largest mine producer of *silver*.

1901 *Silver*-rich and gold-rich Commonwealth of Australia created in January. The government of India began a massive *silver* purchase program, which continued until World War I. Death of Queen Victoria. Continuation of Boer War. Combination of American metal smelters attempted. Populations: North and South America 144 million; Europe 423 million; Australia 6 million.

1902 End of Boer War. South African *gold-silver* mines now under British control. Heavy fall in the *silver* price to the 40-45 cent level. *Gold* discovered at Goldfield, Nevada, east of Silverpeak, an offshoot of the Tonopah *silver* boom of 1900.

1903 Discovery of the famous rich *silver* deposits at Cobalt, Ontario, Canada, during the construction of the Ontario Government's Northern railway, led to intensive exploration of the Shield and the discovery of important *gold* camps in Ontario a few years later, i.e. Larder Lake, Porcupine, Kirkland Lake. The *silver* mines found were the

McKinley-Darragh, Larose, Nipissing Mining, Little Silver and the O'Brien, which was one of the richest in Cobalt. Large purchases of *silver* by the government of India in 1903 and 1904. Australian *gold* production peaked at 119 metric tons.

Canada-Alaska frontier fixed, separating two areas rich in gold and *silver*.

1904 France surrendered most of its lucrative exclusive fishing rights along part of the Newfoundland coast. Russo-Japanese War. Government of India purchases *silver*.

1905 The O'Brien *silver* mine opened in Ontario. Mexican Mints closed to Free Coinage of *Silver* as the revolution began. Large exports of *silver* dollars from Mexico. End of Russo-Japanese War. Internal troubles in Russia. Continued purchases of *silver* by the government of India in 1905 and 1906.

1907 Purchases of *silver* by the government of India cease. Sharp fall in the *Silver* price. Financial crisis in U.S.A. Panic causes a run on the banks, stopped by J.P Morgan's importation of $100 million in *gold* from Europe with the assistance of the Rochschilds.

1908 *Gold* discovered in the Porcupine area, Ontario. Royal Canadian Mint opened in Ottawa, Ontario. Large gold imports by France. Heavy fall in the *silver* price to the 40-45 per cent level. Canberra became the capital of Australia.

1909 Establishment of the Ontario Provincial Police to ensure order in the new *silver* rush and gold rush mining camps of Northeastern Ontario, such as Cobalt and Porcupine. Hollinger, McIntyre and Dome gold veins discovered in the Porcupine area, Ontario. World *silver* surplus.

1910 Death of King Edward VII. India's Import Duty on *Silver* increased from 5 per cent ad valorem to 4 annas per ounce. *Gold*-rich Union of South Africa inaugurated by merger of the Boer republics with the British colonies there. Mexican Revolution.

1911 *Gold* discovered in Kirkland Lake, Ontario. Manchu dynasty falls in China; Republic formed. Italy at war in Tripoli, North Africa. Population of Ireland fell to 4.39 million, from 8.5 million in 1841.

1912 Government of India purchased 6 million pounds sterling of *Silver*. "Rupert's Land" north of Ontario was granted to Ontario — the area was later a major producer of *silver* and *gold*. Turkey at war in the Balkans, Europe.

1913 Chunilal Saraya, Chairman of the India Specie Bank, attempted to corner the *silver* market, but eventually failed. He accumulated over 800 metric tons of *silver*, equivalent to 20 per cent of world mine output of *silver* at that time. Chunilal Suraya used to buy all the *silver* in the world all year long so that when the India Office, the purchasing agent of the Government of India, for whom Mocatta were the buyers in those days, needed *silver* to coin money, i.e. *silver* rupees, they had to buy it from Chunilal Suraya. Year in and year out, he sold his *silver* at a profit to the India Office, which slightly miffed, eventually bought *silver* secretly for one whole year and therefore did not have to buy it from Chunilal Suraya. However, he had counted on the India Office as the customer again. When they did not buy, the bank failed, he went bankrupt and committed suicide. To take the 800 tons off the market, because that quantity might cause a price collapse, the leading London bullion dealers formed a syndicate to buy it all and dispose of it quietly. The Government of India bought 5.5 million pounds sterling of *Silver*. Frederick Soddy of Britain coined the term isotope and received the Nobel Prize for Physics in 1921. Dr. Herbert N. McCoy, 1907-1945, U.S. chemist, with W.H. Ross, clearly identified the existence of isotopes now used in medicine etc. Balkan War.

1914	Outbreak of World War I in August and consequent disorganization of Money and Stock Markets. Record coinage of *Silver*. *Gold* standard suspended by warring powers. Britain unofficially abandoned the gold standard. Mining of *silver*, *gold*, copper, nickel, zinc, lead, coal etc. in Canada expanded from $9.4 million in 1890 to $58.3 million in this year. Cecil Rhodes made his famous speech on September 5, including "MINING IS THE BACKBONE OF WEALTH AND THE SPINAL COLUMN OF ALL CERTAINTY".
	Mining in Canada was greatly stimulated by the war.
1915	*Silver* price fell to the 40-45 cent level in September.
1915-1916	Continuation of World War I. Heavy coinage of *Silver*, as certain governments refused to accept paper currency and demanded payment for war materiel in *gold* and *silver*.
1916	Price inflation — average price of *silver* 65.7 cents U.S. per troy ounce. Electric induction furnace developed. Used to produce *silver*, *gold*, platinum group metals etc. U.S. troops sent to Mexico.
1917	Russian Tsar abdicated. Revolution; Soviets take over Russia in a second revolution. Continuation of World War I. The United States declared war against Germany; free export of *gold* prohibited. Dominion of Newfoundland created.
	Silver price rose to U.S. $1.085 In September, but dropped to 83 cents in October, anticipating the Pittman Act.
1918	Armistice with Enemy Countries signed by the Western Allies on November 11th. Serious political unrest continues in Russia and Germany. Most members of the Russian Royal Family murdered. The *silver*, *gold* and platinum mines were seized by the Soviets. Pittman *Silver* Act passed in the United States, directing the U.S. Mint to melt 10,885 metric tons of *silver* in dollars to sell as bullion and supply Britain with 9,330 metric tons of *silver* for coinage into rupees (for payment for war materiel from India where British paper money was not acceptable) and to purchase the equivalent on the domestic market at U.S. $1.00 an ounce.
1919	Peace treaties with Central Powers signed by the Western Allies. Canada's status as a self-governing nation vigorously asserted. High prices of commodities such as *metals* and wide fluctuations in International Exchanges. Britain abandoned the gold standard officially. Heavy *silver* buying by China. *Silver* at an all-time high of U.S. $1.375 in November-December. Civil war in Russia continues. The *silver* coins of the vanished regimes, Imperial Austria, Imperial Germany, Imperial Russia etc. start to be melted down. First ever non-stop flight across the Atlantic by Sir J.W. Alcock and Sir A.W. Brown, from St. John's Newfoundland, now Canada, to Clifden, Galway, Ireland, 1,936 miles in 16 hours, 12 minutes.
1920	Canada issued 5, 10, 25 and 50 cent coins with reduced *silver* content. *Silver* price goes to below U.S. $1.00 by May. Economic crash in U.K. Because the *silver* price was 89.5 pence per ounce and the coins became worth more as metal than the face value, British subsidiary coinage was debased to 500 fine *silver*. Heavy Continental sales of demonetized *silver*. World-wide depression in trade. India's *Silver* Import Duty remitted.
1920-1933	The purchasing power of *silver* was to increase by 32 per cent.
1921	British Royal mint commences selling surplus *silver* from debased coinage; continental *silver* sales continued. *Silver* price drops to 52.5 cents in March. U.K. returns to a

	conditional gold standard. O. Stern and W. Gerlach show that a beam of atomic *silver* is split into two distinct beams on passing through a nonhomogeneous magnetic field. Irish Free State created in December.
1922	Sales of surplus *silver* by U.K. Royal Mint and European Continental sales continue. Sterling exchange on New York appreciates. German paper Mark completely valueless owing to inflation. Irish Free State inaugurated.
1923	Royal Mint and European Continental sales of *silver* continued. Market price of *silver* went to 65 cents. Purchases of silver by U.S. Treasury under Pittman Act completed. Value of the German paper mark drops to 4 million marks for one U.S. dollar. Political unrest widespread. Death of Wilhelm Roentgen, born 1843, who discovered X-rays in 1895.
1924	*Silver* and copper coins minted by the USSR. Large European Continental purchases of *silver* for coinage. Recoinage of British Currency suspended while the Royal Mint was coining for Foreign Countries.
1925	*Gold* discovered in the Red Lake district in Ontario. *Gold* Standard, suspended 1914, conditionally restored by Winston Churchill as a so-called "Gold Exchange Standard", in U.K. Serious unrest in China.
1926	Declaration of Imperial Conference led to the Statute of Westminster, 1931, which gave formal status to Canada's equality with Britain, bound by allegiance to a common Crown. France returns to a form of gold standard, fixing it at the market price of U.S. $25 an ounce. Report of the Royal Commission on Currency in India was unfavourable to *silver.*
1927	The Government of India sold 280 metric tons of surplus *silver* in London.
1928	Sales of *silver* from demonetized coin by France, Belgium and India, offset by large purchases by China. First colour motion pictures exhibited by George Eastman in Rochester, New York.
1929	World Economic Crisis begins. *Silver* price declines through 1932. Heavy drain of *gold* to France and Germany from U.K. "Black Friday," October 29, U.S. stock market collapse. U.S. securities lose $26 billion in value. India demonetizes *silver.* Government of India sales of *silver* continue. U.S. paper money one-third smaller in size went into circulation, July 10.
1930	World-wide trade depression. Break in *silver* and China exchanges. Indian Government continue *silver* sales and reimpose import duty of 4 annas per ounce.
1930-1940	Depression. Huge *silver* stocks, but little industrial use for *silver.* 1930-35 period: 70 ounces of *silver* worth 1 ounce of *gold.*
1931	Continued depression. Indian *silver* import duty increased to 1½ annas per ounce. Britain abandons the *gold* standard on September 21 and the pound sterling was devalued 40 per cent. British Statute of Westminster declared Britain and Canada and the other Dominions completely equal "in no way subordinate one to another".
1931-35	Amazing new finds of *silver, gold* and radium in Canada's Northwest Territories.
1932	*Silver* price fell to a record low of U.S. $0.2425 an ounce. U.S.S.R. instituted a campaign to gather in all *silver* held by the people in the form of ornaments, coins etc. for which the owners were paid in paper roubles.
	O'Brien-Cadillac mine in Quebec commenced milling. Continued depression. High *gold* price induced sale of about 15 million pounds sterling of *gold* and sovereigns

previously hoarded in Great Britain and Ireland. Oath of allegiance to Britain repudiated by the Irish government. From September, 1931, to the end of 1932, 450 metric tons of *gold* exported from India.

1933 The purchasing power of *silver* had increased by 32 per cent since 1920. The *silver* price rose quite sharply through 1935. Banking crisis in U.S.A. in March followed by U.S. abandonment of gold standard on April 19th. U.S. citizens prohibited from owning gold. This was to last for over 41 years. Unlimited purchases of newly mined *silver* by the U.S. Later, the U.S. Treasury gradually discontinued the purchases of *silver* of non-U.S. origin. Treasury began at a price of 64.64 cents. World Economic Conference met in London, June 12th. Signs of trade revival in Great Britain. Exports of Gold from India about 34 million pounds sterling. Financial situation of the Dominion of Newfoundland desperate: parliamentary government suspended. Mine output of *silver* in Peru rose from 1933 through World War II.

1934-35 New Price of *gold*, U.S. $35 per ounce, fixed by U.S. President Franklin D. Roosevelt on January 31 as U.S.A. returns to *gold* standard, with the U.S. dollar devalued to 59.06 percent of its former value, i.e. from 23.2 to 13.7 grains of *gold*. All *gold* privately held by U.S. residents had to be surrendered to the government for $20.67 an ounce. Ownership of *silver* by U.S. individuals permitted. U.S. "*Silver* Purchase Act" passed on June 20th.; *silver* much more valuable — price for *silver* $0.719, (compared to $0.282 three years before). U.S. permits debtor countries to pay the U.S. government in *silver* at a rate of 50 U.S. cents per troy ounce. U.S. agrees to purchase its own domestic mine production of *silver*, to help the Bank of England. New York Commodity Exchange closes *silver* trading. Physical Exchange silver stocks surrendered to U.S. Treasury for only 50 cents an ounce. Domestic *silver* transactions taxed at 50 per cent. Heavy purchases of *silver* by U.S. at home and abroad. The year 1935 was especially marked with commotions in the realm of *silver*. The main objective of the United States Silver Purchase Act was to establish and maintain a metallic backing for the currency at 25 per cent *silver* and 75 per cent gold. The amount of *silver* required to balance this program to the end of 1935 was set while the amount in Washington was insufficient. To provide the remainder, the government bought *silver* heavily during the year, largely through London. The result was a world flow of *silver* to Washington from all the silver-using or *silver*-owning countries of the world. U.S.S.R. shipped 3.11 metric tons of *silver* to the U.S.A. to buy U.S. dollars to help pay for essential imports from the U.S. Russia was not believed to have any large stocks of *silver*. China forced to divorce exchange from *silver*. China disgorged some 7,500 tons of *silver* coin in the mid-1930's. China almost emptied itself of *silver*. In November the government of that country completely prohibited its export, and also forbade the use of silver, its age-long medium of exchange, for currency purposes. Further, it nationalized the country's entire stock of the metal, and substituted a managed currency, not linked to any monetary system, but stabilized the Chinese dollar at 1s. $2\frac{1}{2}$d. The Chinese *silver* dollar was replaced by an non-convertible paper note, issued and controlled by a central bank.

Hong Kong followed the lead of China in its sales of silver. Mexico did likewise and soon fell into dire distress. On 9th December, the United States government, suddenly and without warning, ceased to buy. The result was to bring chaos in London and other *silver* markets. There was a wild rush to sell stocks of *silver* that had been accumulated to meet the expected United States demand. Prices fell from $29\frac{3}{16}$d. per standard ounce to $20\frac{7}{8}$d. Some relief was felt by a moderate demand from India, attracted by the lower price. The efforts of the United States government to force up the world price of *silver* and enhance the value of the metal for currency-backing purposes, were not effective, but they brought serious trouble to nations who from time immemorial have used only *silver* as a medium of exchange. Import duty on *silver* reduced in India. August 3, Hitler becomes both President and Chancellor of Germany, i.e. Dictator. Persecution of the Jews and re-armament commenced.

Canadian gold and *silver* mining "boom" quickly develops in Ontario, Quebec and Manitoba, following the U.S. government price increases. Sullivan mine in Quebec commenced milling. Jackson-Mannion mine, Patricia district, Ontario commenced milling.

The expansion in newly mined *silver* and gold in Ontario, 60 per cent of Canada's output, stimulated by the revaluation of gold by President Roosevelt in 1934 created essential foreign credits ("hard" money) both before and during World War II, 1939-45. Ontario produced a record 99.3 metric tons of gold in 1941, compared to 45 tons in 1925.

1935-36 Canada issued a *silver* 1-dollar coin. During the years 1930 to 1935, the Royal Canadian Mint in Ottawa, Ontario, refined crude gold bullion from Ontario mines alone to the extent of 418 metric tons, from which were recovered 44.52 metric tons of *silver*, or at a rate of 0.1065 troy ounces of *silver* for every ounce of crude bullion. Bank of Canada established, the country's central bank and the holder of the government gold reserves. Gold bullion tax in Canada discontinued from June 1st. Italo-Abyssinian (Ethiopian) War. Tension in Europe. Huge purchases of *silver* in London by U.S. Treasury. *Silver* reached 81 U.S. cents in April due to heavy speculative buying. Hong Kong and China forced to abandon *silver* standard.

1936 Canadian federal income tax amendment exempted new or reopened metal mines. Pamour mine at Porcupine, Ontario came on stream. Death of King George V. Devaluation of Currencies by "gold bloc" countries. Large shipment of *silver* to India. Abdication of King Edward VIII. Accession of King George VI. Long Period of stability in the Royal Family begins. Civil War begins in Spain; Soviet Union supports one side, Fascist Italy and Hitler's Germany the other, with the latter side triumphing eventually. The Soviet Union accepted the bulk of the remaining gold in the Spanish Treasury as security payment for arms and aircraft for the Civil War; 500 metric tons or more of gold were secretly airlifted to Moscow.

1936-1937 U.S. President Roosevelt visits Canada officially twice.

1937 China-Japan War commences. Chinese Government transfer *silver* reserve, about 8,397 metric tons, to Hong Kong and later to London. Between 1931 and 1937, the U.S. Treasury acquired more than 93,000 metric tons of *silver*.

1938 Canada was now the world's second largest mine producer of *gold*. Germany annexes Austria and forces partition of Czechoslovakia. War scare in Europe. Heavy purchases of *gold* by Continental operators.

1939 New Canadian *Gold* Clauses Act passed. Anaconda Mining Company was producing 5 per cent of the world's *silver* in Montana. The fabulous treasure found at Sutton Hoo in Suffolk comprising many *gold* and *silver* artifacts in a ship-tomb burial is believed to be that of the Anglo-Saxon Redwald, 616-627 A.D., the fourth "Bretwalda", a title in mixed Celtic and Saxon meaning "Ruler of Britain"; see 1942.

King George VI and his consort, Queen Elizabeth, visit Canada, the first reigning sovereign to do so.

German aggression causes successive crises and the opening of World War II. Germany and the Soviet Union invade Poland on September 1. Great Britain and France declare war on Germany on 3rd September. Canada follows September 10th. Soviet Union invasion of Poland from the East results in Soviet forces facing German forces at the new boundary line. Russia attacks Finland.

Canada's newly mined *silver* output was 720 metric tons; gold 158 tons. Canada's mineral production was greatly altered by the War. Scope and direction diverted from "non-essential" metals such as *gold* and *silver* to iron, nickel, copper etc. for war materiel.

1940 Germany invades Denmark, Norway, the Low Countries and France. Winston Churchill takes command in the U.K. Italy declares war on Allies. France capitulates. Britain fights on alone in Europe. Disintegration of Italian African Empire. India's *silver* currency debased to 500 fine. Italy and Germany attack certain Balkan countries.

1941 Germany attacks Russia. Japan attacks U.S. forces in Pearl Harbour, Hawaii, December 7, without declaration of war. U.S.A. and Great Britain declare war on Japan. Germany and Italy declare war on U.S.A. Rainbow Bridge between Niagara Falls, N.Y. and Niagara Falls, Ontario, Canada opened.

1942 A largely Canadian force attempts a disastrous raid on Dieppe, northern France. U.S. and British forces land in Northwestern Africa. The veteran British 8th Army continues west to join those new U.S./British Forces. U.S. price controls introduced.

The Mildenhall Treasure, a remarkable and superb hoard of Roman *silver*ware, buried probably in the 4th Century A.D. in the troubled times in Britain just before Roman rule ended, is discovered in Suffolk. One marvellous *silver* dish is nearly 2 feet in diameter. Anglo-Soviet Treaty.

1942-1945 Half of the U.S. government's huge silver bullion reserves were used as electrical conductors serving industries in World War II and as loans to Britain for their minting of *silver* coinage, particularly *silver* Maria Theresa dollars, the only money trusted by Middle East and *silver* rupees for Indian suppliers of war materiel. (Basic distrust of paper currencies still true in 1985).

1943 German and Italian forces in North Africa surrender to General Alexander, late Irish Guards, Allied Land Forces commander in Tunisia. Control of Africa's mineral wealth safely in the hands of the British, the French and the Americans. Italy surrenders to the Allies. New Act instructs U.S. Treasury to sell general fund seigniorage *silver* to U.S. industrial users.

1944 Allied troops land in Northern France — 3 Canadian divisions, 14 British, 20 U.S., 1 Polish and 1 French, totalling about 2.88 million men.

1945 World War II ends with unconditional surrender in May of all German and later, in August, all Japanese forces after dropping of the second atomic bomb, made from Canadian uranium. Deaths of Mussolini of Italy and Hitler of Germany earlier in the year — Hitler after only 10 years and 8 months of rule. U.S. Office of Price Administration raised the *silver* price. Gold reserves of Western Europe had been greatly depleted in World War II. Much of it went to the U.S.A.

1945-49 Chinese paper currency became worthless (425 million yuan for one U.S. *silver* dollar), paving the way for Mao. See 1949.

1946	World-wide shortage of food. Shipments of *silver* to India recommence. *Silver* coinage debased completely in Great Britain and cupro-nickel substituted. (The U.S. followed this route less than twenty years later). Britain starts to melt down *silver*-bearing coins withdrawn from circulation to recover the *silver* for return to the U.S. under wartime "lend-lease" terms. Shipments of *silver* to India recommence. End of U.S. OPD price controls and release of pent-up wartime demand.
1947-1950	Expansion of demand. Import of *silver* into India suspended. Break-up of the British Empire commences. India, Pakistan, Burma and Ceylon achieve independence. Surge in jewellery demand, boosting *gold*, *silver* and platinum, combined with curtailment of output by producers.
1948	Ontario government introduces the 15/65 rule into the Mining Tax, which had the effect of helping to keep many *gold* mines open during the long years of the fixed price, which ended in 1968. Political unrest in Europe. Irish Free State becomes Republic — leaves British Commonwealth.
1949	What is now Canada's richest *gold* mine, Campbell Red Lake in northwestern Ontario, commenced production. Newfoundland joins Canada as its tenth province. U.K. pound devalued from U.S.$4.03 to $2.80. Communists take over China. Economic recession.
1950	Korean War broke out. U.S. Marshall Plan dollars start to flow to Western Europe. French *gold* reserve revalued. Canadian dollar freed. Advent of Catalytic reforming in the petroleum industry. India becomes a republic. World population estimated as 2.4 billion. Compare 1850 1.1 billion and early 1984 4.8 billion.
1950-61	*Silver* market stabilized by the operations of the Mexican and U.S. governments.
1950-67	The huge U.S. stockpile of *silver* (largely from the Comstock), supplied large coinage requirements and huge new industrial demands. *Silver* stockpile greatly reduced.
1951	Gold production from the large new Orange Free State area in South Africa commenced.
1951-1953	Korean War price controls in several countries.
1952	Accession of Queen Elizabeth II on the death of her father, George VI.
1953	Armistice in Korea. Post-Korea stockpiling by U.S. of strategic metals, some from Canada. Large amounts of Russian *silver* and *gold* consigned to London.
1954	London *Gold* Market reopened, March 22. U.S. economic recession.
1956	Britain returns 2,050 metric tons of "lend-lease" *silver* to the U.S.A. Britain and France invade Egypt. Suez Canal blocked by 49 ships. British and French troops withdraw.
1957	Bank rate February 7th 5 per cent. All lend-lease *silver* had been returned to U.S. by Britain. The U.S. received in all 3,110 metric tons of *silver* as returns of "lend-lease" metal. Surplus U.K. *Silver* sold in London. Bank rate September 19th 7 percent. Remarkable recovery in sterling.
1959	More countries return to *silver* coinage. Labour troubles in the U.S.A. lead to temporary shortage of *silver* both there and abroad. U.S. Treasury free stock of *silver* over 6,900 metric tons.
1960	Rumours of devaluation of U.S. dollar cause rush of speculative *gold* buying. Highest quotation over $40 per ounce, 20th October. *Silver* would reach this price twenty years later for a short while. U.S. Treasury free stock of *silver* was 3,420 metric tons.

1961	China a large seller of *silver*. U.S. Treasury stops selling *silver* to domestic industrial users. Sharp price advances in New York and London. *Gold*-rich South Africa, the world's largest producer, declared itself a Republic and left the British Commonwealth. The country's accumulated *gold* bullion reserves were no longer part of the U.K.'s Sterling Currency Area, which was ultimately bearish for sterling, contributing to a major devaluation of sterling a few years later. London *Gold* Pool established. (It would last less than 7 years.) U.S. Treasury free stock of *silver* now only 680 metric tons, approximately. From end 1933 to end 1961, the U.S. Treasury had acquired an astonishing 94,721 metric tons of *silver*.
1962	Mexico stops selling *silver* in New York, September 24th. Record high prices for *silver* in London and New York in October.
1962-3	A splendid treasure hoard of Roman *silver* of 350 A.D. or after was found at Kaiseraugst, Switzerland including unusually large *silver* dishes, a *silver* statuette of Venus, 3 *silver* ingots and 186 coins.
1963	U.S. *Silver* Purchase Act repealed. New Act of June 4 authorizes issue of 1-dollar Federal Reserve notes not backed by *silver*. *Silver* Futures market reopened June 12th. President Kennedy assassinated November 25. U.S. Treasury sells *silver* to all comers at 129.293 U.S. cents per ounce. First large scale redemption of U.S. *silver* certificates, (up to 1963 the only form of the U.S. 1-dollar bill), for physical *silver* from the U.S. Mints took place on September 12.
1964	Heavy sales of U.S. Treasury *silver* continue. New York price unchanged at 129.3 cents. London *silver* price at new high.
1965	U.S. Johnson Coinage Act 1965 passed, demonetizing *silver* completely, except for the half dollar with a greatly reduced *silver* content. Cupro-nickel U.S. coins issued in lieu of *silver*. Heavy sales of U.S. Treasury *silver* continued. U.S. Treasury *silver* stock dropped by 1 billion ounces (31,103.5 metric tons) to only 796 million ounces in the 5 years to end-1965. U.S.S.R. ships 280 tons of *Silver* to U.K. World production of diamonds totals 342,000 carats.
1965-1966	U.S. recession.
1966	Sales of U.S. Treasury *silver* continue. New York price unchanged at 129.3 cents. Soviet Union halted *gold* sales and began to buy *gold* in the West. U.S. begins drawing down certain metals from its strategic stockpiles as the Viet Nam War escalates.
1967	Canada issues 10 and 25 cent coins with the *silver* content greatly reduced, to 50 per cent, from 80 per cent, in August. See 1968. In the previous 20 years, Canada had used about 4,200 metric tons of *silver* in coins. U.S. *silver* policy change. *Silver* sales by U.S. Treasury ceased. Wide fluctuations follow. Heavy buying of *gold* and *silver* due to currency fears. Private melting of *silver* in the U.S. and Canada forbidden. Melting down U.S. *silver* coins was illegal in the U.S. for about 2 years. June: 6-Day War, Israel vs. Arabs. Devaluation of the pound sterling to U.S.$2.40. *Gold* in heavy demand late in the year. U.S. Treasury announced that it would withdraw old *silver* coins from circulation and the minting of new U.S. *silver* coins was suspended. The historical *silver*/gold price ratio of about 15:1 returned.
1968	Canada becomes the world's leading mine producer of *silver* and remains in that position through end 1974. A year after Canada's reduction of the *silver* content of new coins, virtually all of the *silver* coins, old and new, had disappeared from circulation. Many were acquired by speculators who smuggled them to the U.S.A.

where it was then quite legal to melt them down and recover the *silver*. (It took the Royal Canadian Mint several years to meet the demand for new coins.) The "silver" coins were changed to pure nickel coins which went into circulation in August. These included a Canadian 1-dollar coin of pure nickel.

U.S. "*silver* certificate" paper dollar bills were exchangeable in the U.S.A. for physical *silver* metal bars only until June 24. After that, redemption was in paper "Federal Reserve" dollar bills. Free market in gold permitted. "Two-tier" gold price system operative. U.S.A. off the gold standard de facto. Free market gold price reaches U.S.$42.60. Wide fluctuations in *silver* price due to speculative pressures. Mine output of *silver* in Peru reached 1,057 metric tons a year.

1968-1974 Canada the world's largest mine producer of *silver* in this period as the polymetallic mine at Kidd Creek, Ontario becomes the world's single largest mine producer of *silver*.

1969 Continued fluctuations in *gold* and *silver* prices. Agreement reached by the I.M.F. and South Africa on *gold* sales at end of year. Free market price touched U.S.$35 in December. President Nixon announced a phased withdrawal of U.S. troops from Vietnam. There were then 550,000 U.S. soldiers there. Canada continues to be the world's leading mine producer of *silver*. The Swiss franc was worth 23 U.S. cents and the West German mark 25 U.S. cents. Compare the late 1984 parities: Swiss franc 40 U.S. cents; West German mark 33 cents U.S.

1969-70 U.S. recession.

1970 *Gold* price falls to U.S.$33 an ounce. U.S. economic recession continues. Extension of the Vietnam war to Cambodia, (Khmer, now Kampuchea). South African *gold* sales to I.M.F. and free market continue. U.S. Treasury withdrew as a seller from the *silver* market November 10th. since 1963, more than 55,000 metric tons of silver from the Treasury stock had been marketed or utilized for U.S. coinage. Canada continues to be the world's leading mine producer of *silver*.

1971 The *silver* price fell to U.S.$1.29 an ounce. Member banks of the U.S. Federal Reserve system were forbidden to hold *silver* coins as part of their assets to satisfy reserve requirements. U.S. government attempts to freeze the price of *silver* and fails. World currency uncertainties. President Nixon shuts *gold* window. Starts wage and price controls. United States suspended conversion of dollars into *gold* 15th August. Free Market price reached U.S.$43.975 December 6th. U.S. Dollar officially devalued by 17 per cent December 18th. Decimalization of sterling currency. Sales of *gold* by the U.S.S.R. recommence. South Vietnamese, with U.S. air support, advance into Laos. Canada remained the world's leading mine producer of *silver*. Federal government in Ottawa makes tax changes which adversely affected the Canadian mining industry in the next decade.

1972 The world's first gold futures contract freely traded on the Winnipeg Commodity Exchange, based on Toronto, Ontario vaults. Canada remains the world's leading mine producer of *silver*. The U.S. Cost of Living Council removed control ceiling price for *silver* August 10th. President Nixon withdraws from Bretton Woods Currency Agreement. *Gold* price explodes and reaches a high of $71 in August. Increased *gold* consumption by industry. U.S. ground forces in Viet Nam War now only 69,000 men. The largest diamond (969.8 carats) ever discovered, "The Star of Sierra Leone", was unearthed in Sierra Leone, West Africa. U.S. government attempts to freeze the price of *silver* — see 1971 — but fails.

1973	U.S. government announced proposed sale of 3,654 metric tons of *silver* from official stockpile. U.S. government attempts to freeze the price of *silver* again — see 1971/72 — but again fails. Continued rise in *gold* price. It went over U.S.$100/ounce for the first time in May. U.S. dollar crisis continued. Second U.S. dollar devaluation in two years, by another 10 per cent and set at U.S.$42.22 an ounce. "Two-tier" *gold* price system terminated in November. October war in the Middle East. Arab nations embargo oil exports to the U.S.A. for six months. Canada remains the world's leading mine producer of *silver.*
1973-75	U.S. Recession.
1974	Discovery of major *gold* deposit by Amoco in the Detour Lake area of Northeastern Ontario, Canada. World crude oil prices quadruple between October, 1973 and March, 1974. Gasoline prices much higher. Very substantial rise in the *gold* price. By the end of 1974, the *gold* price had risen to U.S.$198 an ounce. Boom in other metal prices. U.S.A. legalises *gold* ownership by U.S. citizens, effective at the end of the year. Speculative buying as a monetary and inflation hedge followed by a severe U.S. economic recession, lasting to 1976. India legalized export of *silver,* but this would not last long. Canada's last year as the world's leading mine producer of *silver.* Resignation of U.S. President Nixon.
1975	U.S. citizens permitted to own *gold* on January 1, banned since 1933. *Gold* Futures Trading begins in U.S. Major drop in *gold* price. Slight easing of the U.S. economic recession. First U.S. government auction of *gold. Silver* exports from India increased by more than 50 per cent to over 1,337 metric tons. Soviet grain crop failure; output fell to 140 million tons. Saigon falls to the Communists. Vietnam War ended in April. Commodity Futures Trading Commission began operating. Canada is the free world's second largest mine producer of *silver.*
1976	I.M.F. begins regular gold sales. Gold falls to U.S.$103 an ounce. "Bottoming-out" of U.S. recession. Soviet Union reduces the size of its bread loaf. Canada the free world's second largest mine producer of *silver.* Between 1876 and 1976, the Homestake gold mine in South Dakota yielded 218 metric tons of *silver.*
1977	The Queen's *Silver* Jubilee of her accession to the throne. Small rise in gold price. I.M.F. starts restitution of some gold to members. Continued economic recovery. Canada the free world's second largest mine producer of *silver.*
1978	Major rise in gold price commences; record price of U.S.$200/ounce in July. End of the "official" *gold* price. *Silver* price averaged U.S.$5.40 in the year. President Carter announces massive dollar support program, including U.S. gold sales. U.S. government *gold* auctions restart. Revolution in Iran results in a slowdown in the output of that major producer's oil production. Vietnam attacked Cambodia. Soviet Union again reduces the size of its bread loaf. Canada the free world's second largest mine producer of *silver.*
1979	The purchasing power of *silver* had increased by 241 per cent in the 46 years since 1933. Anxiety buying of oil induced by the cut-off by the Iranian revolutionaries caused world oil prices to double. Record *gold* prices. U.S.$300/ounce in July, 1979, (double that of 12 months before). Soviet grain crop problems again; output only 185 million tons, estimated. U.S. and I.M.F. reduce monthly *gold* sales. U.S. Treasury ends monthly *gold* auctions. U.S. recession begins. Boom in precious metal prices. November: *Gold* price goes to over U.S.$400 an ounce. *Silver* price escalates in the second half to above U.S.$18.

The rapid rise in the *gold* and *silver* prices toward the end of 1979 was caused in part by international political crises in the Muslim world such as

1) the rise of anarchy in Iran; the seizure of the U.S. Embassy by Iranian revolutionaries in Teheran, Iran on November 4, and the taking of U.S. diplomats as hostages;
2) the temporary occupation of the Great Mosque in Mecca by dissidents;
3) another OPEC oil increase;
4) the Soviet invasion of Afghanistan on December 27.

1979-82 U.S. recession.

1980 Major attempt to corner the *silver* market. *Silver* and gold prices at all-time highs. *Silver* price over $48.80 an ounce January 17, but fell to $10.40 in late March. Gold price went to U.S.$850 an ounce on January 21, and fell back; settled in the $500-$600 range. Platinum went to over U.S.$1,000 an ounce.

Only a small tonnage of Soviet *gold* sold to the West during the year. Poor Soviet grain crop. The troubles in Poland start with meat shortages and the Solidarity movement begins to strain Soviet-Polish relations. Iran-Iraq war begins; their oil exports reduced.

Boom in precious metal prices continues, although prices go lower.

U.S. recession, January through July, 1980.

World mine output of *silver* was almost double that of 1950. *Silver* consumption dropped to a 16-year low. Peru's mine output of *silver* reached 1,400 metric tons. Canada was the Western World's third largest mine producer of *silver*.

1981 Discovery of the large Hemlo *gold* deposits which also contain *silver* in north central Ontario, Canada. Announcement that the large Detour Lake *gold* deposit in Northeastern Ontario is to be put into production, with first stage output to commence in mid-1983 (which was achieved). Canada was the third largest mine producer of *silver* in the Western world. President Reagan scrapped price controls on oil. New U.S. law authorized the sale of stockpile *silver*, 3,265 metric tons over 3 years. Poor Soviet grain crop. Disastrous Eastern European grain crop.

1981-82 U.S. recession, July, 1981 to November, 1982.

1982 Canada again overtook Mexico as the free world's largest mine producer of *silver*, according to Samuel Montagu merchant bank. *Silver* price fell to a low of U.S.$4.88 in June and then doubled later in the year as Soviet buying of *silver* greatly increased. Peru withheld *silver; gold* dropped to a low of $295.50 on June 21. Martial law declared in Poland. Falkland Islands War. Glut of oil continues. Poor Soviet grain crop.

1983 The new *silver*-bearing Detour Lake *gold* mine in Ontario, Canada commenced output. Royal Canadian Mint the largest precious metal mint/refinery in North America; refined 118 metric tons of gold in 1983. Supplies of *gold* available in the Western world totalled 1,160 metric tons, 5 per cent below 1982. Poor Soviet grain crop. Gold prices in U.S. dollar terms fell about 20 per cent, but in U.K. sterling the gold price was relatively constant.

1984 The U.S. paper dollar is now (1984) worth 3.4 cents of its 1940 value in constant dollars. The Canadian dollar is worth even less, in constant 1940 U.S. dollar terms.

U.S. and Canadian *silver* coins however are *worth many times their 1940 face value.* A pre-1964 U.S. silver dime is now worth about 50 cents U.S. Late in the year, the Swiss franc was worth 40 U.S. cents; the West German mark 33 cents. See 1969. The U.K. government ceased minting the bronze "half-penny"; it had started out in the 13th Century as a *silver* coin. Poor Soviet grain crop. U.S.S.R. will probably import 50 million metric tons of grain worth U.S.$8 billion in the winter of 1984-85. Such purchases usually have a damping effect on the gold and *silver* price. Very heavy tax-loss selling, plus fears of another big cut in crude oil prices by OPEC combined to push gold down to its lowest price level since mid-1982 and this brought the *silver* price down too. The heavy flow of foreign funds into the U.S. began to slow sharply. Prime Minister of India Indira Ghandi assassinated. Some platinum group metals went to dramatically higher prices: the price of rhodium rose during the year from U.S.$350 to $900 an ounce and to over $1,000 by mid-January, 1985. Ruthenium rose from U.S.$40 to $175 an ounce; Osmium rose to around U.S.$900 an ounce. U.S. government is resuming the strategic stockpiling of palladium, which averaged 1984 at U.S. $148.18 an ounce, and will purchase about 53 metric tons. Ontario benefits because it is the world's third largest mine source of these precious metals of the platinum group and such stockpiling helps to strengthen the price.

1985 At the first of the new *silver*-bearing Hemlo *gold* mines, (Noranda), in Ontario scheduled to come into production in January, 1985, the orebody was contacted on December 20, 1984.

The second new Hemlo *gold* mine, (Teck), capital cost C.$154 million, in Ontario should be into ore in January, 1985.

(The *silver* content of the Hemlo ores may be between 1 and 2 g. per metric ton. The grade in the initial contact area of the Noranda Hemlo mine was 0.28 troy ounces of gold per ton.)

Metals Week quoted an authority as saying that silver should strengthen to U.S.$9 or $10 by the end of 1985 and gold to $400.

1986 The third new *silver*-bearing Hemlo *gold* mine, (Lac Minerals), in Ontario plans to start open-pit production in August, 1985 and open its mill in the spring of 1986. When in full production in 1988-89, it should produce 14 metric tons of gold a year and some *silver*, making it North America's largest gold mine.

Sources: T.P. Mohide; Sharps, Pixley, London; Dr. H. Jarecki, Chairman, Mocatta Metals Corporation; Handy & Harman; Jerome F. Smith; Professor R.W. Jastram, University of California, Berkeley.

Chapter 4 Free Commodity Markets for Silver (Where the Silver Price is Created)

THE TRADING VOLUME FOR SILVER IN DOLLAR TERMS IS THE FIFTH LARGEST IN THE WORLD, (AFTER GOLD, OIL, COFFEE AND RICE).

IN THE U.S.A. IT IS FIFTH LARGEST AFTER SOYA BEANS, CORN, WHEAT AND GOLD.

Turnover on the silver futures markets in the U.S. quadrupled in two years through 1983 and that of palladium quadrupled also.

Trading activity in U.S. silver futures in 1984 increased to 103 metric tons a month, compared to 90 metric tons a month in 1963.

Silver Traded

(metric tons)

	1981	**1982**	**1983**	**1984**
on New Comex (Commodity Exchange)	193	446	1,000	n.a.
on Chicago Board of Trade	39	36	85	n.a.
Totals, New York Comex and Chicago B.O.T.	232	482	1,085	1,236 (Total U.S.A.)
on London Metal Exchange	14	33	46	n.a.

The strong dollar of 1983 and 1984 has been keeping some U.S. and Canadian investors away from silver, temporarily.

COMMODITY FUTURE MARKETS

The first use of a futures contract was recorded in Japan in the 1600's. Commodity futures trading was established in Chicago, U.S.A., London and continental Europe by the 1850's. Futures contracts evolved because of the need to protect both seller and buyer.

The silver market is controlled by those who own silver.

DURING THE LAST FOUR YEARS OR SO, THE WORLD SILVER MARKET HAS UNDERGONE A FUNDAMENTAL ALTERATION.

IT NOW HAS A MUCH STRONGER, EXTREMELY BROAD BASIS OF INTERESTS WHICH RANGE FROM THE MAJOR CENTRAL BANKS AND FUND MANAGERS TO LARGE NUMBERS OF INDIVIDUAL MEMBERS OF THE PUBLIC AROUND THE WORLD BUYING QUITE SMALL QUANTITIES OF SILVER IN BAR OR COIN FORM, AN ACTIVITY HOWEVER WHICH HAS BUILT UP INTO A FORMIDABLE TOTAL.

4.1 THE TORONTO FUTURES EXCHANGE

The Toronto Futures Exchange provides, for the first time in Ontario, a separate and distinct commodity futures exchange, similar to those in Winnipeg, Chicago and New York.

Its new silver option contract is proving very successful.

Options

The Toronto Futures Exchange in Ontario, Canada, which opened on January 16, 1984, offers a 100-ounce silver option. The 3-month contract is listed in U.S. funds and expires in one of the four predetermined months.

The Exchange announced a record turnover in July, 1984 of 17,446 contracts, up 36 per cent from the previous monthly high of 12,774 contracts set in March.

The Toronto Stock Exchange also offers a 1,000 ounce silver option.

Today, many people are attracted to silver investments. Not only is silver considered to be an excellent hedge against inflation, but silver is a natural resource that is an essential industrial commodity. Over the past 10 years silver prices have fluctuated from less than $2 an ounce to over $50 an ounce. Until the introduction of silver options by The Toronto Stock Exchange, investors have not been fully able to benefit from the profit potential nor protect themselves against potential losses directly attributable to the silver price's volatility.

The Toronto Stock Exchange has introduced the first organized secondary market for trading options on silver. The introduction of standardized silver options means that, for the first time, holders of silver may benefit, subject to certain risks, by investing in silver options. Prior to the establishment of the Toronto Stock Exchange silver options market, the only way a holder could realize profit from his silver investment was to liquidate his holding. With options, the holder can generate investment income while still maintaining his silver holdings.

The introduction of silver options at The Toronto Stock Exchange provides investors with a unique investment opportunity — the ability to invest in silver without incurring any of the problems of a physical purchase of the metal or the risks of the silver futures market.

Silver Options

A silver option is the right to buy or sell a specified quantity of silver at a specified price, on or before a given date.

The price per ounce specified in the option is the exercise price. The date is known as the expiration date. The cash amount paid for the option is known as the premium. Silver options trade in U.S. currency.

A silver call option gives the buyer (holder) the right to purchase a specific amount of silver at the exercise price at any time before the expiration date.

A silver put option gives the buyer (holder) the right to sell silver at the exercise price at any time before the expiration date.

Investment Opportunities

Silver options offer many investment opportunities. For the silver owner, they offer the ability to earn income (premium) on a non-interest bearing investment.

Investors who wish to purchase silver but not at prevailing market prices may utilize silver options to set a future acquisition price.

Silver options, unlike silver futures, have a limited risk — the most that may be lost is the premium paid.

Silver options provide investors with the ability to utilize leverage — or the investment of a small amount of money for a potentially large gain — a facility which is not possible in the physical metal market.

Examples of several silver options strategies are available from the Exchange.

Delivery

Delivery is in the form of a silver certificate issued by an approved depository. Delivery of silver bullion against a silver certificate may take up to five business days.

Investors should consult their investment advisers for more detailed information concerning delivery charges, provincial sales tax on bullion, where applicable, and a list of recognized refiners of bullion and issuers of silver certificates.

Intermarket Services Inc.

Intermarket Services Inc., (IMS), a not-for-profit limited liability company, is a wholly-owned subsidiary of The Toronto Stock Exchange which issues and guarantees all silver option contracts that trade on the TSE. IMS positions itself between the buyer and the seller, thus assuming responsibility for collection of the premium from the buyer and guaranteeing payment to the option seller.

Contract Specifications

Trading Unit	100 ounces of 999 fine silver bullion.	
Exercise Price	Price of Silver	Interval
	below U.S. $15	U.S.$1.00
	U.S. $15 to $35	U.S.$2.50
	above U.S.$35	U.S.$5.00
Expiration Date	The Saturday following the third Friday of each expiry month. The expiry months are March, June, September and December.	
Price Multiples	Premiums below U.S.$2.00 — $.05 Premiums above U.S.$2.00 — $.12½	
Hours of Trading	9:30 a.m. — 2:30 p.m. (Toronto time).	
Positions Limits	2,000 put and call contracts on the same side of the market.	
Exercise Limits	2,000 contracts over a period of five (5) consecutive business days.	
Settlement	Delivery and payment on exercised silver options are on the fifth business day following receipt of the Exercise Notice.	
Ticker Symbol	SVR	

For further information on the Silver Options Market one may contact

The Toronto Futures Exchange
The Exchange Tower
2 First Canadian Place
Toronto, Ontario
M5X 1J2

4.2 WINNIPEG COMMODITY EXCHANGE — FUTURES PRICES FOR SILVER

THE WORLD'S FIRST GOLD FUTURES TRADING in "good delivery" gold bars commenced late in 1972, on the 100-year-old Winnipeg Commodity Exchange. Unlike London, trading volume and open interest figures are issued daily. A clearing house of high reputation stands behind each contract. It is used by Americans and Europeans, as well as Canadians. Silver contracts were added later.

The Winnipeg silver and gold contracts have proved to be professional and international in scope and many large multi-national corporations and investment trusts have switched a portion of their liquid funds into them. The Winnipeg Gold and Silver Futures Market has proved to be a stabilizing element, allowing industrial users a hedging mechanism against price changes. The price discovery and risk shifting functions have proved to be extremely valuable.

There are presently silver futures contracts trading on the Winnipeg Commodity Exchange.

ONTARIO BENEFITS DIRECTLY AND CONTINUOUSLY FROM THIS TRADING BECAUSE THE PHYSICAL GOLD AND SILVER BARS HELD AGAINST EACH GOLD OR SILVER FUTURES CONTRACT ARE ACTUALLY STORED IN THE TORONTO, ONTARIO VAULTS OF THE BANK OF NOVA SCOTIA OR OF THE CANADIAN IMPERIAL BANK OF COMMERCE. JOBS IN TORONTO AND DISPOSABLE INCOME IN ONTARIO HAVE RESULTED.

The Winnipeg Commodity Exchange gold and silver futures contracts have been approved under Ontario's Commodity Futures Trading Act of 1978.

The 400 ounce contract and the later centum represented the world's first exchange-traded gold futures contracts and effectively remained so until January 2, 1975.

In Canada, gold was and is traded completely freely either on a cash basis at banks, or on a futures basis at Winnipeg from 1972. A process to free up gold in the U.S.A. was under way.

U.S. LIBERALISATION OF PRIVATE GOLD PURCHASES IN THE U.S.A. AND RELEASES FROM U.S. GOVERNMENT GOLD STOCKS.

The U.S. Congress in 1973 authorized the President at his discretion to permit the domestic ownership of gold. In December, 1973, U.S. citizens were given the legal right to own gold coins minted up to end-1959, not 1934 as previously. Then at the end of 1974 came permission to own bullion gold.

American citizens have thus been allowed to own bullion gold since the beginning of 1975.

In the U.S.A., the purchase and sale of fine gold bullion for industry was strictly controlled by U.S. Treasury licensing procedures until December 31, 1974. Gold markets have operated in the U.S.A. under the new law only since then.

At that time, the restrictions on ownership of gold bullion by citizens of the United States were removed and gold futures contracts were speedily approved by the Commodity Futures Trading Commission for several major U.S. commodity exchanges. At present, gold and silver futures contracts are offered in the U.S.A. on the Chicago Board of Trade, Commodity Exchange Inc., the International Monetary Market and the Mid-America Commodity Exchange.

The gold and silver futures contracts are instruments which fulfil the economic purpose of a mechanism for hedging against price risk. Indeed the impetus for the creation of these contracts on the Winnipeg Commodity Exchange sprang partly from the recognized need for some form of hedging mechanism for custom refiners, mine producers of gold and silver and commercial users of gold and silver. This need had become particularly acute following the introduction of the two-tier international gold pricing system in 1968, in which the monetary price was fixed, but the free price was allowed to fluctuate in the open market. Silver was freed in 1967.

The early years of trading in these contracts in the Winnipeg Commodity Exchange were characterized by a heavy involvement on the part of hedgers as well as the anticipated U.S. gold licensees of the U.S. Treasury and Europeans. In fact, the new members attracted to the Winnipeg Commodity Exchange included a large number of industrial users of gold, many of whom were able to take long and short positions in order to minimize market risk in dealing with both producers and downstream consumers.

The Winnipeg Commodity Exchange introduced silver futures trading early in February, 1981.

Delivery Point in Ontario

Deliveries of gold and silver are on the basis of silver warrants or a gold certificate issued by a Canadian chartered bank, approved by the Exchange, providing for delivery of the gold or silver at the bank's principal office in Toronto, Ontario. The banks approved for delivery on Winnipeg futures are The Bank of Nova Scotia and The Canadian Imperial Bank of Commerce.

4.3 FUTURES EXCHANGES – CHICAGO, U.S.A.

The world's largest commodity exchange by far is called the Chicago Board of Trade. Futures trading started there in the 1850's in agricultural products. Precious metals came later. The Board of Trade, as it is affectionately known, has many futures contracts. A very popular one, introduced in 1983, is the silver mini-contract for 1,000 troy ounces, instead of the regular 5,000 ounces. There is also a gold mini-contract for 1 kilogram or 32.15 troy ounces, instead of the normal 100 ounces. Such is the leverage of futures that the small man can put down only U.S.$400 and control say $12,600 worth of gold at May, 1984 prices. This is well within the range of the average investor.

The Board of Trade has had an overwhelming response to the new silver contracts.

Open interest records were set for the 1,000 ounce silver contracts in the first half of 1984. Open interest is the number of futures contracts that have not yet been offset by opposite transactions. Contracts on several days in May, 1984 exceeded the previous high of 42,332 contracts on February 28, 1983 and went to 48,065 contracts on May 18, 1984. This is attributable to long-term forward commitment levels in the metal.

4.4 NEW YORK FUTURES EXCHANGES

The New York Mercantile Exchange (Mercex) and the Commodity Exchange (Comex), New York, offer important futures contracts in silver in various forms.

4.5 LONDON SILVER BULLION MARKET AND THE LONDON METAL EXCHANGE

The London Gold Bullion Market consists of five firms and three of them, Mocatta and Goldsmid, Samuel Montagu and Sharps, Pixley comprise the Silver Bullion Market. It is interesting to note that one member was founded in 1684, ten years before the Bank of England obtained its charter and the most recently formed member was founded in 1853.

It may be as well at this point to explain how the cash price of silver is determined in the U.S. In London, the Silver Bullion Market comprises three firms through whose hands silver is bought or sold. Representatives of these firms meet every week-day and the price of silver bars is fixed according to the amount by which the offers to buy exceed or fall below the offers to sell. If the former predominate, the price is increased in accordance with the preponderance; if sellers offer more than buyers require, the price falls. The vagaries of the silver market, due to political and economic considerations, have been surprising.

In London, since 1919, the Gold Bullion Market, comprising N.M. Rothschild and Sons Ltd.; Samuel Montagu; Mocatta and Goldsmid; Sharps, Pixley (formerly Sharps & Wilkins and Pixley & Abell) and Johnson Matthey, dealing with each other as brokers or as principals, issues the bullion brokers' spot gold price at two daily fixings. The commercial grade sold is minimum 99.5% purity.

The so-called London Bullion Market list of "accepted Melters and Assayers" shows those firms whose stamp makes a gold bar "good delivery". See Chapter 10.1.

Since 1971, the London Gold Bullion Market has quoted the gold price in U.S. dollars only.

A considerable amount of gold and silver all over the world changes hands on the basis of the London Second Gold Fix or the Silver Fixing, even though most of such deals based on that price figure do not actually go through the London Bullion Market. TRADING VOLUME AND OPEN INTEREST FIGURES ARE NEVER ISSUED. (In 1968, the London Gold Market was trading an estimated 18 tons of gold a day.)

The LONDON PRICES ENJOY ONE ADVANTAGE IN NORTH AMERICA. THE FIRST PRICE FIXING IS AVAILABLE IN THE EASTERN U.S.A. AND CANADA AT BREAKFAST TIME AND THE SECOND (CLOSING) FIXING IS AVAILABLE THERE AT 10 A.M. FOR MOST OF THE YEAR.

Bullion dealers are exempt from payment of U.K. VAT (value added tax) on every gold transaction.

The London Metal Exchange has a silver 3-months futures contract.

There is no restriction on price movements on the London Silver Bullion Market or the London Metal Exchange, unlike the U.S.A. and Canada.

4.6 OTHER EXCHANGES AND TRADING

Japan

Japan introduced new silver and platinum contracts in 1983 which considerably increased public interest.

The Tokyo Gold Exchange had a turnover of 722,687 silver contracts during the first half of 1984, more than twice what was expected.

Active trading of silver has instilled vigour in the Tokyo Gold Exchange, helping to boost transactions of gold as a side effect. Silver proved an immediate success after the metal was added to the trading list on the floors of the Tokyo exchange January, 1984.

Tatsuo Oka, managing director of the Tokyo Gold Exchange pointed out that about two-thirds of market demand for silver in Japan is met by domestically produced silver and recycled silver. Imports account for only one-third. So silver is less affected by foreign exchange fluctuations than gold which is almost entirely imported.

A new "loco Tokyo" spot physical silver market has been established by Sumitomo, Nissho Iwai and Tokuriki Honten.

Tanaka Kikinzoku Kogyo KK of Tokyo, a prominent dealer in precious metals, commenced the issue of warrants on April 24, 1984, aimed at facilitating investor interest in trading silver on export market. The silver warrants were set at 30 kilos of silver each because of transportation difficulties.

Mitsubishi sells silver to industrial users on a long term basis.

Hong Kong

The Chinese Gold and Silver Exchange in Hong Kong now ranks third only to London and New York in importance with a volume of U.S.$800 million on a good day.

The Chinese Gold and Silver Exchange is very active. Turnover by May 1984 was half a billion dollars per day in exchange transactions. The gold contract is for 100 taels of gold of 99 per cent fineness. A tael of that purity is the equivalent of 1.1913 troy ounces of 1,000 fine, i.e. 100 per cent purity.

4.7 SPECULATION

Henry Jarecki, M.D. has provided a penetrating commentary on speculation in silver. Dr. Jarecki is founder and Chairman of the very successful Mocatta Metals Corporation of New York, a subsidiary of the over 300-year old "Mocatta"/Standard and Chartered Bank, bullion dealers and merchant bankers of London, England, one of the 5 member firms comprising the London Gold Bullion Market, 3 of which comprise the London Silver Bullion Market, including Mocatta. Dr. Jarecki also lectures on psychology at Yale.

He has applied to bullion dealing the same strategy he employs as a psychiatrist: he has tried to eliminate intuition by precisely formulating "facts" that affect the price of whatever it is that is being traded.

He relates that speculation is a word from Latin which has the meaning of watching or spying and has come to mean conjectural anticipation — largely used in the meaning of hoping.

Speculation, or selling or buying something in the hope of making a short-term profit, is just that. Selling or buying something for a profit over a long term is called investment.

The Silver Market is an active, enthusiastic event.

In playing the silver market as a speculator, you really have to know things (news) *before* anyone else does, if it is to do you any good and even that does not always happen. It was many years before the writer realized that, as a trader, he was not so much trading silver, gold etc. as he was trading information, betting that his information was better than the other professional traders competing.

The strength and the weakness of the speculator is his emotional range, from the enthusiasm which leads him to get in too deep to the despair when it all proves to have been poor judgment.

Although it is usually thought of as greed, Dr. Jarecki feels that, because of frequent disappointments, the most important cause of the desire to speculate is the speculator's desire for stimulation and his desire to feel that he is participating in the central events of the world and that he is a somebody. Further, he can be a free person — perhaps more in silver than in other areas.

Why do speculators love silver? Why is it such a speculative vehicle?

Dr. Jarecki points out that there is no person or unit that has a mandate to promote speculation and there is no marketing group pushing silver speculation.

Yet, the trading volume in silver in dollar terms is the *fifth largest in the world*, after gold, oil, coffee and rice.

There is a gold-silver trading volume ratio — not the better known gold-silver price ratio. In 1977, the U.S. markets traded about 1 million gold contracts and about 2.5 million silver contracts, a 2.5 to 1 ratio in favour of silver. The next year 3.5 million contracts of each traded, so the ratio was about 1:1. In 1983, perhaps 12 million gold contracts traded, compared to some 6 million of silver, i.e. the gold-silver trading volume ratio was 2:1.

Another way of looking at things is the ratio between stocks and flows. If world stocks of readily useable silver are say 19,000 metric tons to 25,000 metric tons, that is equivalent to about 18 months or more of world silver consumption, (which is say 12,440 metric tons a year). The stocks to flows ratio is thus very marginal.

By contrast, in gold, the stocks to flows ratio is 60:1, compared to silver's 1.5:1.

Silver has been for quite some time *the most volatile commodity traded*, i.e. an average of 3.8 per cent. Silver's only competitor for volatility is sugar which has averaged 3.2 per cent over the ten years, 1973-82, measured by the average daily price movement expressed as a percentage of the prevailing metal price. Gold ranged between 1 and 3.5 per cent, averaging only 1.9 per cent, i.e. only half the volatility of silver. The volatility of the Standard and Poor index has been only one quarter that of silver, i.e. less than 1 per cent.

As far as average price volatility in individual years is concerned, silver had a 6.8 per cent average daily volatility in 1980, *a record for any commodity*. The runner-up, orange juice, in 1977, had a 5.8 per cent figure. The fourth highest ever volatility was silver again in 1979 with 4.6 per cent and the fifth in 1980 when sugar's volatility was 4.5 per cent.

Dr. Jarecki says that if you are as skeptical as he is about the prospect of predicting future metal prices and believe that speculation is a zero-sum game, then you would have to advise the speculator to trade in whatever commodity has the lowest possible transaction costs. There are very few transactions which cost so little in commissions etc. as silver, when compared to anything else.

4.8 GOVERNMENT SUPERVISION OF SILVER TRADING EXCHANGES

The rules of a futures market in Canada and the U.S.A. are geared to protect the small investor. The trading of gold futures in the U.S.A. is supervised by the Commodity Futures Trading Commission of the U.S. Federal Government. The CFTC offices are in Suite 4747, One World Trade Center, New York, N.Y., U.S.A. 10048.

In Canada, such supervision is carried out at the exchange by a resident representative of the Canadian federal government.

4.9 SILVER DEALERS, TRADERS, BROKERS AND SELLERS

Some of the more important dealers in and sellers of silver and other physical precious metals around the world are:

Canada

Imperial Smelting and Refining Corporation, Markham, Ontario
Guardian Trust International, Toronto
Johnson Matthey Canada, Toronto and Brampton, Ontario
Engelhard Canada, Aurora, Ontario
Philipp Brothers, Montreal
Bank of Nova Scotia, Toronto, Ontario
Canadian Imperial Bank of Commerce, Toronto, Ontario
Inco Ltd., Toronto, Ontario
Degussa Canada

Lac Minerals, Toronto, Ontario
Noranda, Toronto, Ontario
Kidd Creek Mines, Timmins, Ontario

U.S.A.

J. Aron and Company (Goldman Sachs), New York
Johnson Matthey, Pennsylvania, New Jersey
Engelhard Corporation, New York, New Jersey
Philipp Brothers, New York
Handy and Harman, New York
Gerald Metals, New York
Gemini Industries Inc., Santa Ana, California
AG-MET Refining Corporation
AMAX Copper
American Chemical and Refining Company, Inc.
Boliden Metech, Inc.
Colt Refining
Degussa Corporation
Drew Refining Company
Eastern Smelting and Refining Corporation
Federal Refining Company, Inc.
Gannon and Scott, Inc.

U.S.A. (Continued)

Gemini Industries, Inc.
D.F. Goldsmith Chemical and Metal Corporation
Heraeus Midland Processing
International Gold Corporation Ltd.
Leach and Garner
Metal Processing Industries Inc.
Metz Metallurgical Corporation
Pease and Curren, Inc.
PGP Industries, Inc., California
Precious Metals Industries, Inc.
RefineMet International Company
Rheem Metals Inc.
Rhode Island Hospital Trust National Bank
Rothschild Inc.
Sabin Metal Corporation
Stern Metals Company
Paine, Webber
Mocatta Metals Corporation
Dean Witter Reynolds
Sharps Pixley
Shearson Lehman/American Express
Handy and Harman
Brinks
Republic National Bank of New York
Pru-Bache Metals

U.K.

Johnson Matthey
Samuel Montagu
Mocatta
Sharps Pixley
Engelhard
N.M. Rothschild
Ayrton Metals
Gerald Metals
William Rowland Limited

Switzerland

Credit Suisse, Zurich
Swiss Bank Corporation, Zurich
Union Bank, Zurich
Metaux Precieux S.A., Neuchatel

West Germany

Degussa (Deutsche Gold and Silber Scheide-Anstalt), Frankfurt
W.C. Heraeus, Hanau
DODUCO K.G., Pforzheim

France

Cie. des Metaux Precieux, Paris

Belgium

Metallurgie Hoboken

Italy

Metalli Preziosi, Paderno Dugnano
Industrie Engelhard SpA, Rome

Japan

Mitsubishi
Tanaka Kikinzoku Kogyo
Sumitomo
Nissho Iwai
Tokuriki Honten

Chapter 5

Silver in the Earth

Silver is a very white, relatively soft precious metal that is comparatively scarce in the earth's crust and rarely occurs uncombined. It is nevertheless widely distributed and occurs in a variety of ways. Gold is almost invariably found with silver. However, in the earth's crust, about 10 to 12 times more silver is available than gold. Silver constitutes only 73 parts per billion of the earth's crust. Silver's rarity is illustrated by the fact that for every 10 million parts of iron found in the earth's surface there are only 2 parts of silver by weight.

Strangely, the rough 10 to 1 availability ratio for silver and gold almost mirrors the fact that up to 10 ounces of silver are mined in the world for every 1 ounce of gold, about 9:1 currently. Some have therefore argued that the silver-gold price ratio should be in the region of 10:1, i.e. more favourable to silver in price than the current level of about 50:1. This proposition reveals a sad lack of comprehension of the silver market. About 40 ounces of silver are mined for every one ounce of platinum.

Silver is, however, the most plentiful of the precious metals in spite of its general scarcity.

Silver is not often found as more or less pure metal in the native state, (as gold is). It is notably in Norway and to some extent Cobalt, Ontario, Canada and a few other places that is occurs in nature in the free or relatively pure metallic state known as native silver, or it is associated with native gold, copper or other metals.

Gold almost invariably contains minor amounts of silver, sometimes sufficient to form the natural alloy electrum, and on occasion native gold and silver may occur in the same deposit.

The silver existing in sea water in minute amounts, 80 to 280 parts per trillion, derived from terrestrial erosion or submarine volcanic activity, is estimated by some to total two million tons recoverable at certain prices, although others estimate the resource as 164 million tons of silver. Even two million tons is a large amount, considering that it is estimated that, during his sojourn on the planet, man has so far mined a total of less than one million tons of silver.

The principal ores of silver are the complex sulphides containing lead, antimony, arsenic and copper. The lead ore, Galena, is a common source of silver. Common minerals mined for silver are argentite Ag_2S (a silver sulphide), cerargyrite $AgCl$, "horn silver", (silver chloride) and hessite Ag_2Te (silver telluride).

The association of silver with lead is so strong that lead roofing material retrieved from old buildings in Europe is often electrolytically refined to remove the silver content. Similarly, gold and to a lesser extent silver, may be recovered from old copper roofing.

Silver is one of the scarcest and most useful of metals. If only it were not so scarce, we would use much more of it. Most rich deposits of silver in ore have been found in the past few thousand years near the surface of the earth, like cream on fresh milk — a phenomenon called "epithermal deposition" — and therefore many experts believe that most of the rich silver deposits have already been discovered and they have been or are being exhausted at a rapid rate. The "less silver as you go deeper" or the "no silver at depth" phenomena, although not universally accepted by geologists, make up a fact of life in many cases.

The odd exception appears to be where the silver deposited at or near the surface has later been pushed down several thousand feet and the orebody has been turned topsy turvy or on its side in a convulsion of nature. In the Coeur d'Alene area of Idaho, the original surface formation appears now to be at about the 5,000 foot level.

5.1 SILVER RESOURCES AND RESERVES (IN ORE) FOR THE FUTURE

World resources of silver in ore in the ground are calculated to be about half a million tons of silver.

The current world *reserve* base of mineable silver at present prices is about half that resource figure at around 250,000 metric tons, or over 8 billion troy ounces of silver, ostensibly worth about 56 billion dollars U.S. at the time of writing. 75 to 90 per cent of the world's silver reserves occur in mixed ores with lead, zinc and copper, often at great depth. This means that extraction of that silver is chained to the saleability of those base metals, even though a doubled silver price and improved technology might prima facie appear to triple the quantity of mineable world silver reserves.

If the price of silver climbs much higher, say over U.S.$11.00, inactive copper etc. mines which contain silver may be brought into production.

NO COUNTRY HAS GREATER RESERVES OF SILVER IN ORE IN THE GROUND THAN CANADA.

THE KIDD CREEK MINE IN TIMMINS, ONTARIO HAS THE SINGLE LARGEST RESERVES OF SILVER IN ORE IN CANADA AND NORTH AMERICA AND RANKS AS THE THIRD LARGEST IN THE WORLD, AFTER CHUQUICAMATA, CHILE AND MOUNT ISA, AUSTRALIA.

This world reserve base represents only 20 years' supply at estimated rates of silver consumption and other economic variables.

More silver is consumed annually than is mined. This has been true for the last 30 years and will continue to be so for many years yet. Of all the important metals which are mined, silver appears to be the one most likely to offer the highest increase in mine revenues *per unit produced* during the next five or ten years.

The world's known silver reserves are located mainly in North and South America, the Soviet Union and Australia.

In fact, 80 per cent of world total primary silver resources are located in only four countries, Canada, the Soviet Union, U.S.A. and Mexico, in that order, all in the Northern Hemisphere. 50 per cent are in Canada, U.S.A. and Mexico, i.e. North America.

WORLD PRIMARY SILVER RESERVES* IN ORE (ESTIMATED)

(metric tons)

			Per Cent
Canada	50,000	(about 1.6 billion troy ounces)	19.8
U.S.S.R.	50,000		19.8
U.S.A.	47,000	(about 1.5 billion troy ounces)	18.6
Mexico	33,000	(about 1.05 billion troy ounces)	13.0
Australis	32,000		12.6
Peru	19,000		7.5
World Total (including sundry countries)	253,000		100.0 per cent

n.b. Mexico's ore reserves of silver could be exhausted in 18 years — President, Mexican Chamber of Mines, 1983.

*Reserve Base: the in-place demonstrated (measured and indicated) resource currently seen to be usable — U.S. Geological Survey Circular 831; 1980.

Very large surface stocks of refined silver exist in the world, however. Much of this derives from recoveries from scrap and old coins melted down. See Chapter 8. Modest new discoveries of silver bearing ore are also being made which add to the ore reserve picture.

A 1978 report by the U.S. Department of the Interior estimated 189,730 tons of unmined silver in deposits worldwide, plus 513,200 tons in deposits from which silver can be mined as a by-product. Yet despite these vast underground reserves, including Communist countries, mines around the world produced only 8,000 to 9,300 tons a year.

South America, with only a small percentage of the world's estimated silver resources, is an area where, until recently, there was a low level of exploration and funding.

We are going through a relentless and accelerating revolution in the world with regard to the attitude to natural resources, whether they are renewable, such as fish, grains and oilseeds, or non-renewable such as metals and minerals. The implications of this simple distinction are often misinterpreted. It is only one side of the coin. The other side is that only renewable resources are consumable, while most non-renewable resources are merely transformable.

Governments of most countries, particularly but not exclusively in the third world, that produce natural resources are saying in various ways that they intend to get a greater economic return for them, particularly when they are non-renewable and commodity prices are not high enough for their liking. They would love to "fix" the prices permanently high, but all such attempts at cartel manipulation have failed.

Incidentally, under the Canadian Constitution, the governments of the Provinces have the control over natural resources in their areas of jurisdiction, which provide the bulk of Canada's resources output by value.

Production of metals from mines for the world market is no longer characterized and dominated by private ownership. There is currently an increasing proportion of mines in the world owned by governments or their agencies, including silver producing mines in Peru, Chile etc.

Many mining companies are at fault in having failed to do enough exploration in safe countries such as Canada to replace ore reserves.

Silver will not be an exception in this trend to economic nationalism. Natural resources could eventually give Canada and other resource producing countries a stronger bargaining position internationally, such as in G.A.T.T., but low world base metal constant dollar prices that are expected deep into the future, (except for gold and silver), may spoil that hope. Canada's great historic strength, resources, is losing value in the marketplace and mineral resource prices, (other than the precious metals such as gold, silver, platinum etc.), will remain depressed in average constant dollar terms as far out as the eye can see.

Short term developments in the silver price do not have a direct effect on mine output of silver.

A doubled silver price and improved mining technology might triple the quantity of mineable world silver reserves, which are mainly in low grade deposits, but extraction rates would still be largely chained to world demand for copper and for lead to some extent. Certain individual base metal mines could then become "silver mines" where silver becomes the most valuable of the metals extracted.

PRELIMINARY ESTIMATES TOTAL WORLD RESERVE RATIOS U.S.B.M. DATA

Metal	**(Estimates made in 1979) Number of Years of Reserve**	**(Estimates made in 1968) Number of Years of Reserve**
Silver	17	20
Gold	13	26
Zinc	24	23
Tin	39	19
Lead	46	32
Tungsten	52	40
Copper	74	52
Nickel	84	141
Molybdenum	86	463
Cobalt	92	109
Platinum Group Metals	117	133
Manganese	250	85
Chromium	358	423

Note: Not independently verified.

The reserve figures used for 1968 and 1979 are not exactly comparable. The point is that all reserve ratios exceed mine planning horizons.

Over ten years ago, the U.S. Bureau of Mines made an assessment of known world mineral resources, (as opposed to recoverable mineral reserves of a realizable commercial value), and while not claiming more than 65 per cent confidence in the results, suggested that there may have been then as little as 22 years of silver left in the ground. Ore *reserves* of recoverable silver would probably be about half of that resource level, so on that kind of basis, the early 1990's could be indicated as a termination for silver ore reserves as they were known in 1973. However, the U.S. Bureau of Mines' 1980 estimates postpone that termination possibility into the 2000's.

The caution here is that actual proven reserves of such silver-bearing metallic ores seldom exceed 12-15 years supply, but of course this may not continue to be the case indefinitely. Mexico's silver reserves may be exhausted in 18 years according to the President of the Mexican Chamber of Mines in 1983.

Far more exploration activity is clearly required.

5.2 EXPLORATION FOR SILVER, GOLD AND OTHER PRECIOUS METALS

> "The meek shall inherit the earth, but not its mineral rights."
>
> — J. Paul Getty

There are probably more exploration and development expenditures currently going into the search for precious metals than into any other single aspect of mining.

The odds of discovering a major orebody of sufficient size and high grade to justify putting it into production at a cost of hundreds of millions of dollars have been estimated at about one in 1,500.

SILVER IN ORE RESERVES — CERTAIN SELECTED MINES — ESTIMATED

CANADA	
Ontario	(metric tons of silver)
Kidd Creek Mine, Timmins, Ontario	5,550
Inco Ltd., Sudbury, Ontario and Thompson, Manitoba	1,600
Geco Mine, Ontario, Noranda	750
Mattabi mine, Ontario, Noranda 60 per cent, Abitibi — Price 40 per cent	370
British Columbia	
Equity Silver Mines, Main Zone and Southern Trail	2,300
Cominco, Sullivan mine, Canadian Pacific	1,500
New Brunswick	
Heath Steele	1,600
Yukon Territory	
Cyprus Anvil, Faro, Yukon Territory	
Anvil mine	1,370
Grum development, $240 million	930
Total Cyprus Anvil	2,300
U.S.A.	
Bingham, Ray and Chino mines, Kennecott (Chino, Mitsubishi 25 per cent)	3,700
Ozark Lead, Kennecott	3,050
Twin Buttes, Arizona, Anamax (Anaconda-Amax)	3,050
Troy, Montana, Asarco 75 per cent	1,850
Berkeley and Carr Fork mines, Montana, Anaconda/Arco	1,700
Sunshine Mine, Idaho	1,300
White Pine, Louisiana Land and Exploration	1,200
Delamar, Earth Resources, Idaho, Superior Oil and Canadian Superior Oil 47.5 per cent	1,200
Escalante, Ranchers/Hecla, Utah	1,000
Buick, Amax, Homestake 50 per cent	970
Galena, Asarco, Idaho	870
Coeur, Idaho, Asarco 50 per cent, Callahan 45 per cent, Hecla 5 per cent	700
Candelaria, Hawthorne, Nevada, Occidental Petroleum, (Others 40 per cent)	630

SILVER IN ORE RESERVES — CERTAIN SELECTED MINES — ESTIMATED (Continued)

Mexico	(metric tons of silver)
Real de Angeles, Placer Development, Vancouver, Canada 34 per cent, Frisco 33 per cent, Fomento Minero (government) 33 per cent	4,400
San Martin Division, Industrial Minera Mexico	3,000
Santa Barbara unit, Industrial Minera Mexico	2,900
Cia. Minera de Cananea	2,800

n.b. Mexico could exhaust its silver reserves within the next 18 years, according to the President of the Mexican Chamber of Mines in 1983.

Peru	
Yauricocha mine, Centromin (government agency)	4,300
Total for Centromin government mines	n.a.
Chile	
Chuquicamata, Codelco (government agency)	5,600
El Teniente, Codelco	4,800
Australia	
Mount Isa, Lead orebody, Asarco/MIM	8,000

Note

While the ore reserves of a silver-producing mine can, theoretically, rise with a strong increase in the world price of silver, in most cases they will not, because the output of such mines — mostly base metal operations — is still largely chained to the amount of copper, lead, zinc etc. that each mine can sell in the light of then prevailing base metal prices, which do not unfortunately appear to have a very exciting future in real terms.

A mine that primarily produces silver, of course, gains enormously from a strong rise in the world silver price.

5.2 SOURCES OF SUPPLY – HISTORICAL AND CURRENT

During the past 6,000 years, it is estimated that, in total, man has mined something approaching 900,000 metric tons of silver.

It is even more startling perhaps to hear that it is estimated that about 80 per cent of all the silver metal ever mined in history is still available to man, say 700,000 tons or more in hoards, art objects, old coins, jewellery, stocks etc.

Three-quarters of this very large total quantity of almost a million tons was mined in the Western Hemisphere, (Canada, U.S.A, Mexico and South America), during the four and a half centuries since the Spanish conquest of Peru and Mexico.

Through 1980, the peak output since 1900 was 8,500 metric tons of silver in the free world in 1940. 1981 went to 8,800 tons and it has been in the 9,000's each year since.

North and South America together currently produce about three quarters of the free world's newly mined silver. Only Australia, in the free world outside the Western Hemisphere, produces any substantial amount of silver.

The world currently mines only about 12,000 metric tons a year of newly mined silver. It has risen overall by about 20 percent since 1979. About 250 mines produce silver in the free world. Because of the high silver prices of 1979/80, new silver mining projects were launched and the rate of output at existing mines was increased. High silver prices relative to the pre-1979/80 period have encouraged a great deal of silver mine activity. Mine production in the free world has increased by over 1,555 metric tons of silver a year since 1980. There is no large primary production of silver in Europe, Africa or Asia.

IT IS IMPORTANT TO MENTION HERE THAT SOMETIMES AS LITTLE AS 60 PER CENT OR SO OF THE TOTAL SILVER THAT WAS CONSUMED IN THE WORLD IN A YEAR COMES FROM THE CURRENT OUTPUT OF MINES; SOMETHING UP TO 40 PER CENT BEING OBTAINED FROM THE REFINING OF SCRAP AND FROM DISHOARDING. Metal scrap demand always rises before an economic upturn and metal scrap demand rose in 1984. Western World consumption in 1984 may have been up to 13,500 metric tons, excluding exports to the Soviet Bloc.

One might also mention that during the first half of this century alone, individuals appear to have lost (permanently) or hoarded or melted down about 100,000 metric tons of silver coins alone. Their silver content would now be worth perhaps U.S.$20 billion.

During the last twenty years, silver appears to have been mined in the world at a ratio of 6 up to 9 to 1 compared to gold from mines, with an upward bias in the trend for silver.

SILVER FROM BASE METAL ORES

A large part of the silver production of the world is no longer derived from silver mines, that is to say, mines in which silver is the predominant metal and the chief source of value. No metal of any kind is found in the earth's crust in an absolutely pure condition. All metals are united either by chemical combination or mechanical mixture with other metallic or non-metallic substances. Oxygen forms oxides, sulphur forms sulphides, and arsenic, arsenides. The ores of gold, lead, zinc, copper and other metals contain silver in varying proportions. In the same vein may be found gold, silver, cobalt, lead, bismuth, copper, arsenic and sulphur. Uranium is also common in this association. The constituent sulphur is probably the chief of all substances which enters into such combinations to exercise a contaminating influence.

There are relatively few purely silver mines in world terms. Something like half of all newly mined silver in the world comes from mines that primarily mine copper and another fourth of all silver comes from lead-zinc mine output. Another source of silver is gold mines. About 70 per cent of the silver mined in the world base metal and gold mines counted together comes from copper mines.

By early in 1984, 16 of the leading U.S. copper mines were closed.

The estimated cost of mining silver in the world ranges from U.S.$2 an ounce to maybe $15, with certain isolated examples running much higher than that, probably. The average cost is about U.S.$6 an ounce.

Today we get most of our newly mined silver because we are mining copper, lead, gold, etc. where the true cost of mining the silver is buried in other costs.

However, increased gold and base metal mining does not automatically mean increased silver production since, as these mines are forced to go deeper and deeper, less and less silver tends to be found, usually because of the epithermal deposition effect mentioned earlier.

It is very important that one study carefully the prices of copper, lead and zinc in calculating the availability of mine production of silver. Cutbacks in copper and lead-zinc mine production because of poor base metal prices cause a reduction in by-product silver output, which is a bullish factor for the silver price.

Silver mines per se, as distinct from base metal mines with by-product silver, are getting deeper in the Western World, about 7,000 feet in Idaho. Silver is mined — with gold — in South Africa where some mines reach 12,500 feet down. Primary silver ore is becoming relentlessly lower in grade as time goes on which means that one has to spend more money to hoist many more tons of ore and waste rock to the surface to obtain the same ounce of silver.

Due to a combination of these and many other reasons, the free world's newly mined production of silver from all types of mines, (excluding communist countries), appears to have held steady at an output range of some 6,200 to 9,600 metric tons a year since 1950.

Unlike gold, where higher prices enable mines to take out lower grade ore (and with lower prices go to a higher grade), most newly mined silver output is fundamentally the prisoner of base metal production, except in the USA and parts of Mexico, and cannot be increased or decreased at will to take advantage of silver price changes.

Since silver is not typically mined for itself, its newly mined output level responds mainly to base metal supply, demand and price conditions and not to silver supply, demand and price changes. This "inelasticity" of output must be set against the great influence which the free gold price almost always exerts on the silver price, (as it has continually since about 3,500 B.C.).

Nevertheless, it is still true that some mines close, some new openings, or re-openings, are postponed and mineral exploration is cut back, when silver goes below U.S.$7.00 an ounce.

Most, say 70 per cent, of the newly mined silver these days comes from mines in the Western Hemisphere and Australia which are mainly in the business of mining copper, lead and zinc; the five largest silver producing countries there together produced about 7,200 metric tons of silver in 1983, excluding that mine output which is sold in the form of "coins" by mining companies.

However, the silver-rich copper mines in North America are beginning to stagnate and lose ground to the program of mine expansion in Chile, Peru, the Philippines, Papua New Guinea etc.

Huge loans from U.S. and other Western banks, the I.M.F., World Bank etc. have poured into countries like Chile, Peru, Philippines, Zambia etc. to help their mining projects. However, the last of the capacity expansion projects started since the price run-up of 1979/80 will also probably come to fruition in 1984/85.

Total world output of newly mined gold was expected to rise in 1984, compared to 1983. The same may be barely true of silver, but South American and Mexican newly mined silver output should certainly increase.

Only fourteen countries produce at a rate of more than 100 metric tons of silver a year, Peru, U.S.S.R., Mexico, Canada, U.S.A., Australia, Poland, Chile, Japan, South Africa, Bolivia, Sweden, Spain and Yugoslavia, in that order.

Silver was being mined in about 57 countries in 1983.

Canada overtook Mexico in 1982 to become the free world's second largest mine producer of silver again. Peru led in 1983 and 1981, Mexico being the leader in 1980, 1979 and 1978, according to the eminent London merchant bank bullion dealers, Samuel Montagu in 1983.

Total world output (excluding communist countries) increased to 8,665 metric tons in 1982, they say.

However, a veteran major U.S. authority, the refiners and fabricators Handy and Harman, while agreeing that Peru led the free world in the two most recent years, gave second place to Mexico, then Canada third in 1982, but ranked the U.S. third in 1981, putting Canada in fourth place that year.

Handy and Harman also appear to disagree with Montagu's statement that, excluding communist countries, world mine output increased, stating that it actually fell from about 8,447 metric tons (Montagu 8,450 tons) to about 8,242 metric tons, (Montagu 8,665 tons).

If you find this puzzling, consider this.

There is no absolute data base in these matters. There are only estimates.

To take one example, five independent and respected industry sources estimated Mexico's 1982 mine output of silver at 1,337 metric tons, 1,710 tons, 1,804 tons, 1,804 tons and 2,168 tons — a 62 per cent variation from low to high.

Other relevant estimates, by "Metals Analysis & Outlook" and other, are listed for information.

The world's supply of newly mined silver is not only limited but it is basically stagnant, in spite of the slight increases of the last four years. World mine production of silver cannot be increased easily because about 70 per cent is a by-product of gold and base metal mining governed by quite different factors.

The record high gold and silver prices of 1979 and 1980 gave rise to an uptrend in mine output, but precipitated a marked fall in demand for silver-containing products, particularly jewellery.

When silver is as low as seven to nine U.S. dollars an ounce, many silver mines cannot operate at a profit. Early in 1984, it was considered that a silver price of under U.S.$8.00 would precipitate shut-downs and cutbacks in Coeur d'Alene silver mines, as happened in 1982. Production costs for silver in the Western World range between U.S.$2 and $15, averaging about $6.

With regard to the future of the mining of silver in Ontario, the only two things that are certain are, 1) that good silver values in polymetallic sulphide ores tend to provide a better cushion against the fluctuations in other major metal prices than most other co- or by-products of mines, and 2) that there will always be some production of silver as long as gold mines are in production.

5.3 World Mine Output of Silver

Western World mine output of silver, excluding the Soviet Bloc, was about 9,580 metric tons in 1983. Including the Soviet Union, the world produced about 12,130 metric tons in 1983, according to the U.S. Bureau of Mines. The Economist of London estimates 11,000 metric tons.

('000 metric tons)

							projected	
	1978	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**
Newly mined silver output, Western World, estimated	8.25	8.35	7.95	8.81	9.17	9.58	9.55	9.60-9.90

n.b. see also Chapter 6, Supply and Demand Balance.

The mine output of silver in the free world in the first 80 years of this century has not shown an increase such as the other metals did. Silver from mines has averaged about 8,000 metric tons a year in the eight decades, followed by a growth to about 10,000 tons a year by 1984. The mine output of silver has not kept pace with the output of other metals in recent decades, except for 1981-84.

In the 1970's, the average annual rate of increase in mine production in the West was under 1 per cent per year. From 1980, this rate of increase has been more than 4 times that at over 4 per cent a year. That reflects the effect of silver's much higher price in the 1980's.

Western world annual mine output of silver has increased by over 20 per cent since 1980. The last

10 years have seen Canada, Peru plus Australia, each obtain a rising percentage share of world mine output of silver.

Almost half of the free world's newly mined silver comes from North America these days.

The combined Mexico, Canada, Peru and U.S. (i.e. the bulk of North and South American) mine output of silver in recent years was about as follows):

North and South American Mine Output of Silver

(metric tons)

1980	**1981**	**1982**	**1983**
4,890	5,370	5,740	6,010 (6,030, Economist of London estimate)

Five countries, Peru, Mexico, Canada, U.S.A., and Australia, together account for 72 per cent of the mine output of silver in the Western World.

FUTURE MINE OUTPUT OF SILVER

There is a considerable difference of opinion on estimates of future mine production of silver. However, many observers feel that there will probably not be much change in total output in the next few years.

The Silver Institute expects the total output of newly mined silver in the world to increase by 4 per cent in 1984, but only 2 per cent in 1985 and 1 per cent in 1986. The eminent Swiss bank, Credit Suisse, expected it to rise by more than 1.2 per cent in 1984.

WHAT IT TAKES TO OBTAIN ONE METRIC TON OF SILVER FROM THE GROUND.

1) The historical pattern is:

   One metric ton of silver has been obtained from 1,464
   tons of combined lead/zinc/copper.

2) With regard to reserves in ore in the ground:

   One ton of silver could be provided from 3,370 tons
   of combined lead/zinc/copper.

3) Regarding total resources:

   One ton of silver might be obtained from 5,800 tons
   of combined lead/zinc/copper.

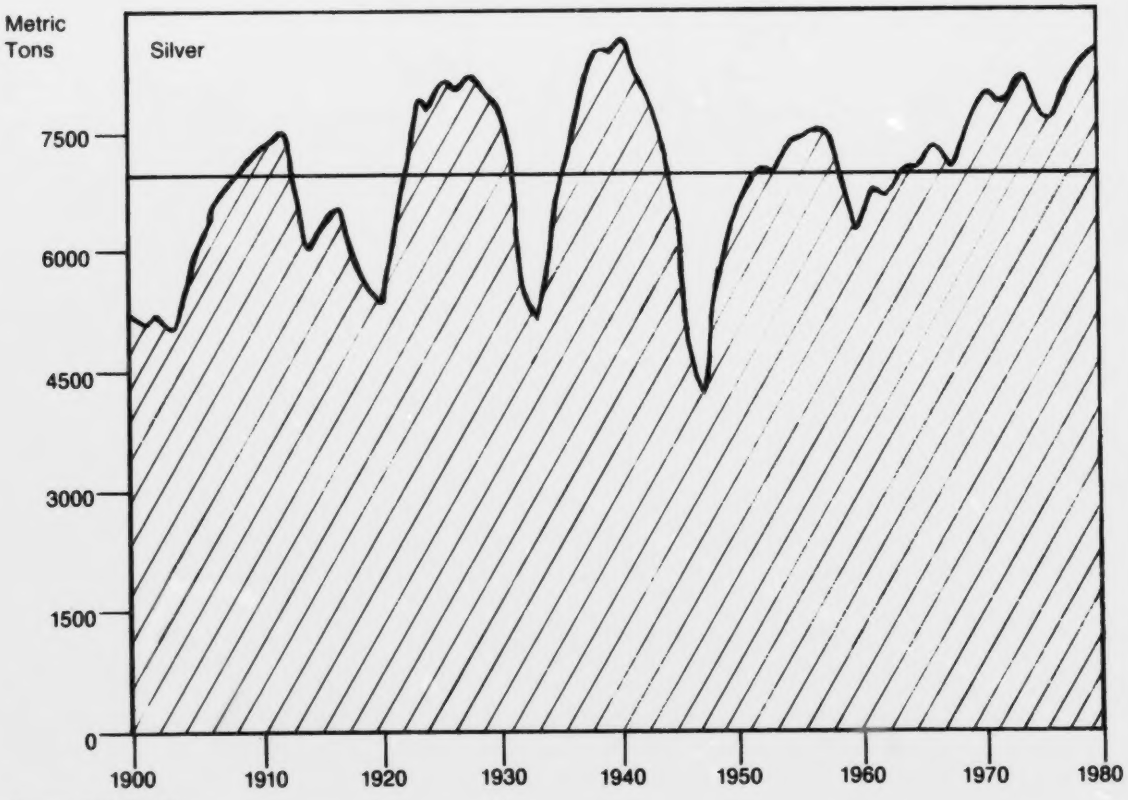
Looking at what it takes another way, in the case of one lead-silver mine, one ton of ore yields 8 ounces of silver, 20 pounds of zinc and 100 pounds of lead.

WORLD SILVER PRODUCTION FROM MINES, FROM 1493 TO 1930

	(metric tons)
1493-1520	1,316
1521-1544	2,165
1545-1560	4,986
1561-1580	5,990
1581-1600	8,378
1601-1620	8,458
1621-1640	7,872
1641-1660	7,326
1661-1680	6,740
1681-1700	6,838
1701-1720	7,112
1721-1740	8,624
1741-1760	10,663
1761-1780	13,055
1781-1800	7,581
1801-1810	8,941
1811-1820	5,407
1821-1830	4,605
1831-1840	5,965
1841-1850	7,804
1851-1860	9,348
1861-1870	12,201
1871-1880	20,118
1881-1890	31,251
1891-1900	48,541
1901-1910	59,794
1911-1920	61,252
1921-1930	74,130

Source: Dr. Adolph Soetbeer to 1850; U.S. Bureau of Mines from 1850.

WORLD MINE PRODUCTION: SILVER
(excluding Communist areas)



Source: T.P. Mohide

The message from the world's mines producing silver is that there is to be very little overall growth in total annual output. By itself, this is neither bullish nor bearish. However, the most probable scenario on total *demand* for silver in the world is that it will grow noticeably each year for a variety of reasons. This situation will tend to force the silver price up.

SILVER MINE PRODUCTION – 1983 – VARIOUS ESTIMATES

Free World, except where stated

('000 metric tons)

	Metall-qesellschaft	**Economist, London**	**Silver Institute**	**U.S. Bureau of Mines**	**Handy & Harman**
Mexico	* 1.91	1.60	1.77	1.71	1.59
Peru	1.72	1.71	1.72	1.68	1.71
U.S.	1.35	1.28	1.34	1.31	1.28
Canada	1.10	n.a.	1.22	1.34	1.24
Australia	1.05	n.a.	1.04	– –	0.96
Other Countries	n.a.	n.a.	n.a.	3.51	2.80
Total	9.88	11.00 (including 1.45 Soviet Union)	9.99	9.55	9.58

*Smelter production: content of silver concentrates by analysis.

Data may not add because of rounding.

Newly mined silver output has risen by over 15 per cent since 1981.

In addition to newly mined silver, there are releases from stocks and there is also a very considerable recovery of silver from various forms of scrap, called secondary silver. See Chapter 5.3.20.

The production of newly mined silver in the world will increase in 1985 to about 13,333 metric tons, according to the Silver Institute in Washington, D.C. This would be roughly 5 per cent above the estimated 1984 output of 12,698 metric tons, which was in turn about 2 per cent above 1983 production of 12,502 tons. The 1984 figure was their projection made that year, based on information from 58 countries. The Silver Institute projects 13,507 metric tons for 1985 and 13,597 tons for 1987.

It ranked the main producers as follows:

	Mexico	**U.S.S.R.**	**Peru**	**U.S.A.**	**Canada**	**Australia**
				(metric tons)		
1985 proj.	2,305	1,710	1,819	1,508	1,260	955
1984 est.	2,084	1,630	1,632	1,450	1,228	914

Metals and Minerals Research Services of London predict a silver output surplus of only 1,244 metric tons. The surplus that will accumulate from 1984 through 1990 will be 6,220 to 7,775 tons, almost half the 1978 to 1984 surplus of about 14,000 tons.

They estimate that total silver supplies will rise from 14,150 metric tons in 1984 to about 17,730 tons by 1990, against total consumption figures of 12,906 in 1984 rising to 17,416 in 1990, i.e. close to total supply that year.

LEADING MINE PRODUCERS OF SILVER

	1981	1982	1983 est.
		(metric tons)	
Peru	1,318	1,692	1,729*
U.S.S.R.	1,580	1,539	1,600**
Mexico	1,640	1,460	1,595***
Canada	1,129	1,204	1,106
U.S.A.	1,265	1,093	1,250
Australia	743	908	1,050
Poland	640	655	675
Chile	361	382	468
Japan	280	306	307
South Africa and Namibia	343	304	283
Bolivia	205	174	187
Sweden	161	168	171
Spain	192	118	185
Yugoslavia	137	105	124
Morocco	100	101	119
Argentina	78	84	76
China, Mainland	65	65	80
Dominican Republic	63	69	39
Honduras	52	64	78
Philippines	63	64	59
Zaire	80	59	39
Italy	55	56	74
Greece	61	49	56
South Korea	41	45	67
Papua-New Guinea	43	43	47
West Germany	39	40	36
Indonesia	26	32	33
France	53	31	21
North Korea	40	30	35
Zimbabwe	27	29	29
Zambia	22	28	29
Finland	38	37	27

* U.S. Bureau of Mines gives 1,680 metric tons. WBMS gives 1,580 tons. Canadian federal government gives 1,654 metric tons for 1982 and 1,387 tons for 1981. Metallgesellschaft gives 1,728 metric tons.

** The figure for the Soviet Union apparently includes refined silver from scrap. U.S. Bureau of Mines gives 1,465 metric tons, including secondary. WMBS gives 1,595 tons. Canadian federal government says 1,579 metric tons for 1981 and 1,539 for 1982. Metallgesellschaft gives 1,600 metric tons. Credit Suisse states that the U.S.S.R. is the world's third largest silver producer, not the second. Silver Institute gives 1,630 metric tons for 1984.

*** U.S. Bureau of Mines gives 1,710 metric tons. WBMS gives 1,846 tons. Mining Annual Review gives 1,900 tons. Canadian federal government says 1,654 metric tons for 1981 and 1,550 tons for 1982. Metallgesellschaft gives 1,911 metric tons smelter production/content of silver concentrates by analysis.

LEADING MINE PRODUCERS OF SILVER (Continued)

	1981	1982	1983 est.
		(metric tons)	
Ireland	19	11	10
Burma	24	16	17
East Germany	45	45	43
Czechoslovakia	35	33	30
Bulgaria	23	25	25
Romania	25	25	25
Brazil	63	53	55
Malaysia	15	16	16
India	17	15	15
Taiwan	7	16	11

Actually, over 76 countries in the world have mines that produce some silver. Saudi Arabia: 20 metric tons a year expected at Al Masane.

Sources: Metallgesellschaft; Samuel Montagu merchant bank; T.P. Mohide; J. Aron/Goldman Sachs; World Metal Statistics Yearbook; Credit Suisse; World Bureau of Metal Statistics; E.M.R., Ottawa, Ontario.

n.b. THE DATA AVAILABLE MUST BE CONSIDERED UNSATISFACTORY, WITH FLAWS LARGE ENOUGH TO DISTORT CONCLUSIONS.

5.3.1 and .2 PROBLEMS OF PERU AND MEXICO

Political and economic problems bedevil mine output of silver in debt-ridden Mexico and Peru. U.S. and Canadian machinery and parts are vital to the mines there. However, those countries have very restricted amount of U.S. dollars or other hard currency and the effect has been that the mines typically cannot obtain enough of the needed spare parts because of the acute shortage of hard currency.

The U.S. government has even discussed trading, or countertrading arrangements with Peru and other Latin American and African governments, under which schemes food would be exchanged for strategic minerals.

Some mines in Mexico can obtain hard currency for imported mine supplies because they are net silver exporters.

It is actually becoming a little questionable as to whether Peru and Mexico will be able to retain their current positions as the two leading free world mine producers of silver, but they desperately need to do so.

5.3.1 PERU

Peru is blessed with enormous mineral wealth.

Francisco Pizarro, 1478-1541, who conquered the Incas in the period 1531-1535, took 134,000 pounds of silver from Peru. By 1545 A.D. the important silver mine at Potosi, Upper Peru, (i.e. southeastern Peru, now called Bolivia), had been discovered. G. Pizarro, half-brother to Francisco, received extensive grants in the Potosi mine. The Cerro de Potosi mines (now in Bolivia), over 4,000 metres high in the Andes mountains, were worked, under dreadful conditions, to produce over 22 tons a year from 1580 to 1610. In 1535, there had been the discovery of the Charcas silver mines in what is now Peru.

Peru's external debt is now U.S.$12.5 billion, a 4 per cent increase over 1982. Real wages there fell by 25 per cent in 1983, and the value of exports was down 11 per cent. A new currency unit, the inti, replaced the sol on February 1, 1985, lopping off three final zeros.

The Government of Peru has given serious consideration to withholding all or some of its silver from the market in the hope of pushing the silver price up. (Of course, its silver output is too small a portion of the world's mine output and secondary recovery of silver, say 1,730 metric tons out of 18,000 tons or so.) Peru apparently believes that its silver is being produced at a cost, in real monetary terms, as indexed to that of silver, above the current silver price. Peru did hold back sales of silver in June, 1982 but abandoned this action by September, 1982.

Mining products account for over 50 per cent of Peru's total foreign exchange earnings.

Peru, however, is desperately short of hard currency and is therefore unlikely to close its silver and gold producing mines in spite of recent relatively low prices. The country clearly needs every ounce of gold and silver it can produce. Peru's average exchange rate against the U.S. dollar was 57 per cent lower in 1983 than in 1982.

A high percentage of Peru's silver is exported, mainly to the U.S.A. and Japan, 1,017 metric tons in 1983, valued by one observer at U.S.$391 million.

Sale of newly mined silver in the first four months of 1984 represented up to 24.6 per cent of Peru's export revenues. Silver and other metals represent half of the country's access to foreign currency.

Peru, through its Central Bank, was obliged to sell 187 metric tons of silver from its central reserves late in 1983, for a 1983 total of up to 290 tons that year, from its 373 metric tons total holdings, (giving silver a monetary role), in order to accommodate its debt restructuring. This helped to depress the silver price. In the first half of 1984, the Bank sold another 62 metric tons, leaving only 31 tons in the reserves.

SILVER OUTPUT OF MINES IN PERU — 1983 ESTIMATED (metric tons)

Metall-gesellschaft	Centro min, Peru	Handy & Harman	U.S. Bureau of Mines	Silver Institute	Mining Annual Review
1,728	1,729	1,710	1,680	1,738*	1,738

* Silver Institute says 1,717 metric tons in 1984.

AS THEN PREVAILING PRICES, PERU'S 1983 MINE OUTPUT OF SILVER WAS EQUAL IN VALUE TO THAT OF ITS PRIMARY PRODUCT, COPPER. THE SALE OF SILVER IS AN IMPORTANT SOURCE OF FOREIGN EXCHANGE FOR THE COUNTRY.

Three of Peru's primary zinc and lead producers reported that their major revenues in 1983 came from by-product silver, Cia. Minera Raura, Cia. Minera Huaron and Cia. Minera Nor Peru.

Peru is currently the world's most important mine producer of silver, an estimated 1,729 metric tons in 1983, about 13 per cent of total world production by their reckoning, up from 1982. However, the U.S. Bureau of Mines gives Mexico first place with 1,742 tons, putting Peru second with nearly 1,680 metric tons, their estimate.

Peru's mine production of silver grew from 482 metric tons in 1950 to 1,390 tons in 1980. Military government reappeared that year with a new mining law to stimulate increased output.

Since 1968, mine production in Peru has been growing at a rate of some 3.5 per cent a year. Part of this is financed by Canada.

Part of the mining industry producing silver could collapse if state aid were withdrawn.

About 80 per cent of all the silver mined in Peru comes from 28 mines located in the western Andes range. 8 of them are silver mines and the others produce silver as a by-product of copper, lead and zinc production.

Three quarters of Peru's silver comes from medium size mines.

The silver mines with high concentrations of silver in their mill products are:

Millotingo
San Juan de Lucanas
Arcata
Caylloma
Orcopampa
Julcani
Uchucchacua

About 99 per cent of the refined silver in Peru is produced at the La Oroya metallurgical complex of Centromin. La Oroya refined 675 metric tons of silver in 1983.

The Silver Institute in Washington, D.C., forecast that Peru will be the number two silver producer in the world in 1984, 1985 and 1986, after Mexico.

Peru's mine output of silver could be higher in 1984. Many mines are modernizing, expanding, updating and building treatment plants. Millions of dollars are being invested to boost output in spite of Peru's problems in servicing its foreign debt.

3 active projects, Tintaya, Casapalca and Andaychagua, could yield 87 metric tons of silver a year.

The U.S.$326 million Tintaya mining project, (state-owned Centromin 41 per cent), Cuzco, Espinar province, a mine of the Ematinsa organization, now under way will be primarily a copper mine producing about 20 metric tons of silver a year. It is expected to be on stream early in 1985.

Financing for the Tintaya project includes U.S.$100 million from the Canadian Export Development Corporation of the Canadian Federal Government and U.S.$115 million from a commercial banking syndicate which includes the Bank of Nova Scotia, Toronto and the Toronto Dominion Bank, Canada. Pre-studies were done by Simons International of Canada and Surveyer, Nenninger and Chenevert of Canada.

The U.S.$19.5 million expansion at Casapalca, 112 kilometres from Lima, 4,191 metres high, in Huarochiri province, department of Lima, should produce about 28 metric tons of silver a year.

The Andaychagua lead-zinc-silver zone of San Cristobal mine expansion project of Centromin, costing U.S.$41.7 million, should produce 39 metric tons of silver a year. An additional loan of U.S.$19 million was requested of the Inter-american Development Bank for this project. The mine's concentrator can handle at least 37 metric tons of silver a year.

The U.S.$548 million potential project in Yauli province, department of Junin, called Toromocho, might produce 80 metric tons of silver a year.

The U.S.$230 million Tambo Grande project in the pre-feasibility stage has reserves of 42 million metric tons grading 1.1 troy ounce silver per ton.

Similarly, the U.S.$500 million La Granja project, in which Mineroperu has special rights, might produce 22 metric tons of silver a year.

The U.S.$279 million Antamina project might well produce 56 metric tons of silver a year in the first stage program.

Following the 1968 Revolution, the large mines were taken over by the state. Previously, virtually all mines were owned by foreign companies.

Centromin, Peru, S.A., (Empresa Minera del Centro del Peru, S.A.), the largest silver producer, the state-owned mining agency, lost U.S.$110 million in 1982. It is the country's principal mining enterprise. It comprises Casapalca Div., Huarochiri; Cerro de Pasco, Pasco; Morococha, Yauli-Junin; Oroya, Yauli; San Cristobal, Mahr Tunel, Junin; and Yauricocha, with its very large silver reserves. (Centromin had hoped in 1982 to be making a profit from 1984 onwards).

Centromin's remote Cobriza copper mine, 2,500 metres high, is particularly vulnerable to terrorists and the Peruvian Army has strengthened its force there against the Sendero Luminoso ("Shining Path") Maoist guerrillas. Cobriza is Peru's most mechanized underground operation. Morococha, 38 Kilometres southwest of La Oroya, 4,509 metres high, is adjacent to the Toromocho zone.

Overall Centromin production costs were U.S.$9.00 an ounce of silver in 1982.

Centromin plans to invest U.S.$71 million in 1984.

Southern Peru Copper, (Asarco, U.S.A., 52.3 per cent, Newmont, U.S.A., 10.7 per cent, Marmon Group, U.S.A. 20.7 per cent, Phelps Dodge, U.S.A. 16.3 per cent), is now the only sizeable foreign owned mining company. It produced 62 metric tons of silver and 70 per cent of Peru's total copper output in 1983.

The break-even point in Peruvian silver mining costs appears to be between U.S.$6 and $7 an ounce, equivalent.

The extraordinarily rich mineral zone at Cerro de Pasco, over 14,000 feet (4,270 metres) high in the Andes mountains, 110 miles (177 kilometres) northeast of Lima, is the centre of the mining area. In the Casapalca silver-lead-zinc-copper deposits, the average silver grade is about 120 g. per metric ton.

Corporation Minera Nor Peru, (80 per cent owned by Asarco, U.S.A.), output 50 tons of silver in the first nine months of 1983, doubled its profits in 1983 to about U.S.$6 million.

Cia. de Minas Buenaventura, Peru's second largest producer of silver, and largest private silver producer, produced in 1983 a total of about 227 metric tons of silver compared to 199 tons in 1982.

The I.F.C., an arm of the World Bank, had agreed early in 1983 to lend the Compania de Minas Buenaventura S.A. in Peru, U.S.$4 million to modernize and expand its operations by at least 60 per cent, to some 217 metric tons of silver a year. The total project cost is $22.1 million, with the balance to come from commercial banks, suppliers' credit and from the company's own cash, $2.6 million.

1) Julcani Unit, Huacavelica, Angares; (increased its silver output in 1983.)
2) Orcopampa Mine, Castilla-Arequipa;
3) Uchucchacua Mines

Expansion will include:

1) three mines in the southern and central Andes
2) increasing ore treatment capacity and
3) adding electrical power.

This was to increase production to just under 220 metric tons of silver a year.

The additional annual output of just under 90 metric tons of silver a year, at a lower cost per ounce, should generate an increase in Peru's foreign exchange of at least U.S.$20 million, making, of course, a number of assumptions.

Buenaventura holds the following: Cia. Minera Condesa 92.4 per cent, Cia. Minera Colquirrumi 52.5 per cent, Sociedada Minera "El Brocal" at Colquijirca, 11 per cent.

San Agustin Mine, Colquirrumi S.A., Hualgayoc, Cajamarca.

The Inter-American Development Bank (IADB) and the government of Peru have agreed to a U.S.$50 million loan, to finance small and medium sized Peruvian mines.

The IADB provides U.S.$20 million and Banco Minero de Peru $30 million, (of which $20 million can be funds from international bank loans). Mining companies must provide about 10 per cent of the capital cost of a venture.

Cia. Minera del Madrigal, near Arequipa, silver-copper-lead-zinc, Homestake, U.S.A. 56 per cent.

Santa Barbara mine, Minsur Sociedad Ltda.

There has been a U.S.$25 million modernization and expansion and a 1983 increase in profit at the Arcata mine of Minas de Arcata, Peru's single largest private silver producer and third largest silver producer, of the Mauricio Hochschild group, which owns 50.1 per cent of the shares. It has an annual capacity of 99.5 metric tons of silver. Mill expansion may add 25 tons of silver a year. 1983 mine output of silver was 99 tons in 1983. Output costs, with smelting and refining, are down to U.S.$5.00 an ounce.

Carahuacra mine of Compania Minera Volcan S.A., Jeses Maria, increased production in 1983.

The Quiruvilca mine, Asarco, U.S.A., 80 per cent, Santiago de Chuco, La Libertad, has increased the output of silver every year since 1979. By end-1983, production had increased by 20 metric tons of silver a year to about 62 tons a year.

Compagnie des Mines de Huaron, (Penarroya, France, 69 per cent), San Jose de Huayllay, Pasco, produces about 67 metric tons of silver a year.

Pachapaqui, a lead-zinc-silver mine, plans an increase in concentrator capacity to 600 tons per day (from 350) by 1986. Cost about U.S. $14 million. 1985 output should be over 37 metric tons of silver and if work is on schedule, 56 tons of silver in 1986.

Other companies are:

Caudalosa Grande Mine, Pisco
Raura and Chanca Units, Compania Minera Raura S.A., Marmon Group, U.S.A., 60 per cent. 1983 output 63 metric tons of silver.

Quenemari Mine, Vida Ingenieros S.A.

Compania Minera Huampar, Colqui.

Colquiminas S.A., Cacachara.

Cia. Minera Katanga at Katanga.

Cia Minera Chuvilca.

Cia. Minera Huanca, Mina Rublo.

San Toribio, Huancapeti-Tarugo, Santo Toribio-Jecanca.

Minera del Hill, Inquilpata.

San Juan de Lucanas.

Sierra Mining, Arapunco-Puno.

Sind. Minero Pacacocha.

Sociedad Minera Puquio Cocha, Morococha.

Vinchos Empresa Explotadora, Vinchos.

PERU — MAIN MINE PRODUCERS OF SILVER

	1983 (metric tons)
Centromin (government), Empresa Minera del Centro del Peru, Casapalca, Cerro de Pasco, Morococha, Cobriza, Yauricocha, San Cristobal, Mahr Tunel and San Expedito	328 (1981)
Minero Peru (government), Empresa Minera del Peru — also markets all state output of minerals. Cajamarquilla zinc refinery. Cerro Verde II U.S.$288 million project due to start up in 1985.	n.a.
Hierro Peru (government) mainly iron	n.a.
Buenaventura, Compania de Minas, Lima (largest private silver producing company)	
Julcani, Orcopampa and Uchucchacua mines only. Huachocolpa output is not known.	219
Southern Peru Copper, Asarco 52.3 per cent, Marmon 20.7 per cent. Toquepala and Cuajone mines. (Most of the U.S.$750 million investment in Cuajone has already been recovered.)	62
Mauricio Hochschild (privately owned — incorporated in Panama, headquarters in Belgium and New York. Permitted to manage a few relatively small mines.	
Arcata, U.S.$25 million expansion completed. 15 ounces silver per metric ton. An important holding in Arcata held by Anglo-American of South Africa 50 per cent, de Beers, South Africa 25 per cent and Minorco, Bermuda 25 per cent, is held through their wholly owned subsidiary, Empresas of Panama.	99
Caylloma mines, Arequipa (1983 grade 11.4 ounces of silver per metric ton)	55
Others (Condoroma, Locumba, Pativalca)	n.a.
Quiruvilca mine, Asarco 80 per cent, government 20 per cent	54
Compagnie des Mines de Huaron, Penarroya, France 69 per cent	67
Alianza, Compania Minera, Ticapampa	37
Milpo, Compania Minera	79
Castrovirreyna, Compania Minera, San Genaro and Caudalosa	43 (1981)
Nor Peru	67
Millotingo	53
Atacocha, Compania Minera S.A., Chicrin mine, Cerro de Pasco	37
Cia. Minerales Santander, lead-zinc-silver, St. Joe, U.S.A., 100 per cent	3

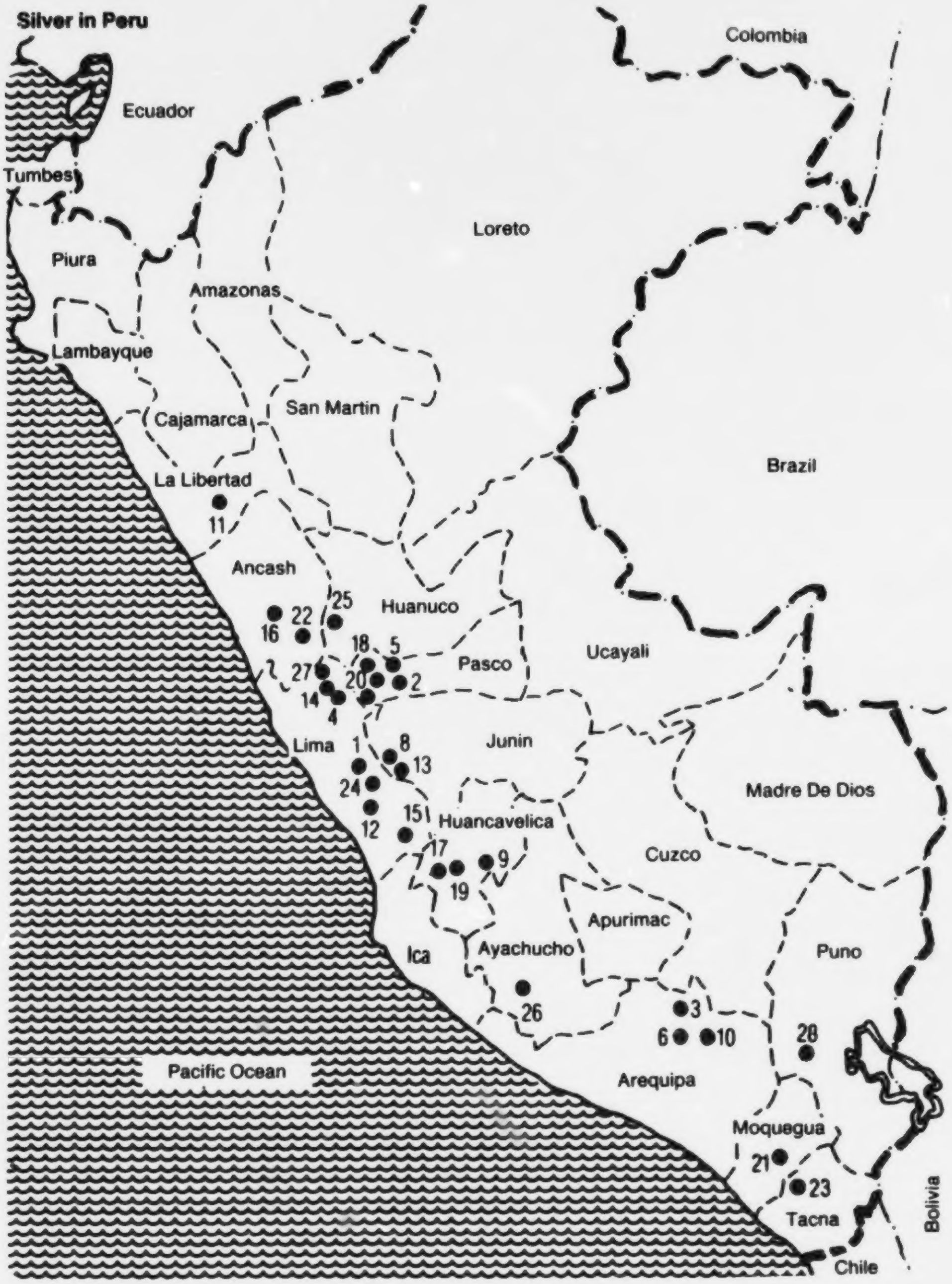
The San Hilarian mine, a joint venture of Cia. Minera Milpo and Mitsubishi of Japan, should come on stream in 1984.

PERU – SOME SILVER PRODUCING MINES – LOCATION (See Map)

Map No.	Mines	1983 Production (metric tons)	
1.	Casapalca	136	(124*)
2.	Cerro de Pasco	134	(118*)
3.	Arcata	99	(93*)
4.	Uchucchacua	92	(93*)
5.	Milpo	79	(56*)
6.	Orcopampa	68	(74*)
7.	Huaron	67	(56*)
8.	Morococha	64	(71*)
9.	Julcani	59	(53*)
10.	Caylloma	55	(43*)
11.	Quiruvilca	54	(62*)
12.	Millotingo	53	(34*)
13.	San Cristobal	51	(50*)
14.	Raura	47	(31*)
15.	Yauricocha	45	(43*)
16.	Alianza	37	(46*)
17.	San Genaro	37	(40*)
18.	Atacocha	37	(40*)
19.	Causalosa Grande	37	
20.	Brocal	37	
21.	Cuajone	34	(40*)
22.	Pachapaqui	31	(12*)
23.	Toquepala	28	(31*)
24.	Santa Rita	28	(22*)
25.	Santa Luisa	19	(34*)
26.	San Juan de Lucanas	19	(22*)
27.	Mina Chanca	14	(15*)
28.	Santa Barbara	12	
	Others	256	
	Total	1,729	

*A. Benavides Q., "Occurrence of Silver in Peru", Mineria magazine, 1984, re Annual Output of Peru-Silver.

SILVER IN PERU


Silver in Peru
Colombia
Ecuador
Tumbes
Loreto
Piura
Amazonas
Lambayeque
San Martin
Cajamarca
Brazil
La Libertad
11
Ancash
25
22
16
Huanuco
18
5
Pasco
Ucayali
27
20
2
14
4
7
Lima
1
8
13
Junin
24
Madre De Dios
12
15
Huancavelica
17
9
Cuzco
19
Apurimac
Ica
Ayachucho
Puno
26
3
6
10
28
Pacific Ocean
Arequipa
Moquegua
21
23
Tacna
Bolivia
Chile

PRODUCTION CAPACITY OF MAJOR SILVER PRODUCING COMPANIES IN PERU

Companies	Treatment Capacity (dst/d)	Type of Concentrate	Silver Production Capacity (metric tons)
Centromin			
Cerro de Pasco	6,300	Pb, Zn	134.3
Casapalca	3,000	Cu, Pb, Zn	136.0
Morococha	1,600	Cu, Pb, Zn	63.9
San Cristobal-Mahr Tunel	1,950	Cu, Pb, Zn	51.0
Yauricocha	1,500	Cu, Pb, Zn	44.5
Cobriza	10,000	Cu	15.7
Buenaventura			
Julcani	700	Pb	58.6
Orcopampa	500	Ag	67.7
Uchucchaucua	700	Pb	91.7
Milpo	2,000	Pb, Zn	79.2
Raura			
Raura-Chanca	1,480	Ag, Cu, Pb, Zn	60.7
Arcata	700	Ag	99.2
Southern Peru Copper			
Toquepala	50,000	Cu	28.4
Cuajone	55,000	Cu	34.2
Huaron	1,300	Cu, Pb, Zn	67.5
Caylloma	650	Ag	55.1
Nor-Peru			
Quiruvilca	1,200	Cu, Pb, Zn	53.7
Others			587.9
Total			1,729.3

OWNERSHIP OF MAJOR SILVER MINING COMPANIES IN PERU — 1983

Company	Ownership per cent
Centromin, Peru, S.A.	
Peruvian government	100.00
Buenaventura, S.A.	
Peruvian government	19.04
Private Peruvian investors	65.91
Foreign investors	15.05
Cia Minera Milpo	
Private Peruvian investors	74.30
Foreign investors	25.70
Cia. Minera Raura	
Private Peruvian investors	40.00
Foreign investors	60.00
Minas de Arcata	
Private Peruvian investors	49.80
Foreign investors	50.20
Southern Peru Copper Corp.	
Foreign Investors	100.00
Compagnie des Mines de Huaron	
Private Peruvian investors	32.50
Foreign investors	67.50
Cia. Minera Caylloma S.A.	
Private Peruvian investors	66.00
Foreign investors	34.00
Corporation Minera Nor Peru	
Private Peruvian investors	20.00
Foreign investors	80.00

5.3.2 MEXICO

Mexico is blessed with more natural resources than West Germany and Japan combined. Its natural resources rank with Brazil's, but Mexico's are much more accessible.

Mexico is a very important mine producer of silver, the second largest or first in the world at present, with 1,595 (or even 1,900) metric tons in 1983. However, the U.S. Bureau of Mines gives Mexico first place, with over 1,710 metric tons, putting Peru second in 1983 with nearly 1,680 metric tons.

A decade or so before, Mexican silver output had been 1,140 metric tons in 1971 and 1,165 tons in 1972.

During the 500 years before the Spanish conquest, the Mexic and Yucatec civilizations had made remarkable progress in the working of various metals such as silver.

Aztec, Toltec and other Indian groups were mining silver in the 1400's. Cortes conquered Mexico in 1519. Nuggets of near pure silver, weighing more than 1 metric ton each were found at Arazuma. Arizuma is the Aztec Indian word for "silver-bearing". The silver mines at Zacatecas were mined by the Spanish from 1534.

Many mines have been worked since the Spanish conquest almost 500 years ago. Cortes himself took away 759 pounds of silver. The Taxco and Pachuca mines discovered in 1522 are probably the oldest in North America. Some of the silver veins have, of course, been worked out.

Mexico became the world's largest silver producer in 1700, displacing Bolivia. Mexico was the world's leading mine producer of silver as recently as 1981. 1984 output could be 1,820 metric tons** of silver, making it again the world's largest producer, if Peru produces only 1,710 metric tons. Mexico's mine output in the first half of 1984 was estimated as 1,000 metric tons of silver, the Planning Ministry said.

SILVER OUTPUT OF MINES IN MEXICO

(metric tons)

1979	1980	1981	1982	1983 est.
1,537	1,473	1,640	1,460 to 1,549	1,590 to 1,911

Sources: Mining Annual Review; T.P. Mohide

However, one should remember that there is no absolute data base — only estimates.

To take only one example of the wide differences between estimates, five independent and respected industry observers estimated Mexico's 1982 mine output of silver at 1,337 metric tons, 1,710 tons, 1,804 tons, 1,804 tons and 2,168 tons — a 62 per cent variation from low to high.

MEXICO — SILVER PRODUCTION (METRIC TONS) — ESTIMATES FOR 1983

Metallgesellschaft	Handy & Harman	Centromin, Peru	U.S. Bureau of Mines	Silver Institute	Mining Annual Review	A.M. Bracho, Mexican Chamber of Mines
1,911*	1,590	1,592	1,710	1,909**	1,900	1,910

* Smelter production/content of silver concentrates by analysis.

** Silver Institute says 2,084 metric tons in 1984.

There are a number of fairly new mines producing silver in Mexico, Real de Angeles, Cuale, Capela, Michoan, Gochica, Senora, Durango, Rosario, Rey de Plata and Sultepec.

Mexico's external debt is now U.S.$90 billion, an enormous sum. However, it has a better chance of getting back on track than Brazil, Argentina or Chile.

The Silver Institute in Washington forecasts that Mexico will be number one silver producer in the world again in 1984 and will retain that position through the end of 1986.

Industrial Minera Mexico say that expansions will add some 466 metric tons of silver to Mexico's output by 1985.

Mexico, a nation of 78 million people with *the world's largest city*, Mexico City, which has 17 million people, is desperately short of hard currency and is therefore unwilling to allow its silver and gold producing mines to close, in spite of recent relatively low prices. It needs every ounce of silver it can get, for sale at any price it can get. About 60 per cent of Mexico's newly mined silver is exported. Mexico's average exchange rate against the U.S. dollar was 71 per cent lower in 1983 than in 1982.

U.S.$1.7 billion will be spent by Mexico in 1984 and 1985 to develop its mineral resources as part of a 5-year plan aimed at raising mining's contribution to national output from 1.3 per cent to 6 per cent by the end of 1988. It is hoped that gold and tungsten resources will be raised to a level of self-sufficiency. The new El Barqueno silver-gold prospect has raised hopes. It appears to contain at least 47 metric tons of silver and 13 tons of gold.

Mexico, like Peru, sometimes puts large amounts of government silver on the world market to help improve its external payments situation. However, in contrast to Peru, Mexican government stocks grew by about 140 tons in 1983. Mexico's Banco Central has been building up its silver reserves in 1984 also. It purchases silver from Mexican refineries at monthly spot average prices. At mid-1984, the Bank was buying about 11 tons of silver a month from Penoles, S.A., i.e. whatever the company's surplus was. The bank also buys spot silver in New York, where it has physical stocks, to replace silver reserve metal sold for minting coins. During the early 1950's, the Bank of Mexico acted as quite a stabilizing factor in the silver market.

Mexicanization of the country's mines accelerated under the 1961 law requiring that 51 per cent of the equity of a company be Mexican owned. Compliance is required by 1986. Nationalization of Mexican banks took place in 1974-77.

Very few of Mexico's mines can be considered as silver mines per se. The bulk of the silver arises as a by-product of lead and zinc mining.

1983 was the first full year of capacity operation of the Minera Real de Angeles, S.A. de C.V., U.S.$123 million new mine in Zacatecas State, between Zacatecas and San Luis Potosi, Mexico. It is *the world's largest open-pit silver mine* and one of the leading silver mines in the world and came on stream early in 1982. Its 1983 output was over 240 metric tons of silver. It should produce at least 243 metric tons of silver in 1984, (helping to increase Mexico's total output, they hope, to some 1,810 tons), say a full 1985 production rate of over 250 metric tons per year of silver, (in lead concentrates) with about 31,000 metric tons a year of lead, as well as some 27,000 metric tons a year of zinc and 415 metric tons a year of cadmium. Reserves of about 60 million tons grade 74 g. silver per ton.

It was expected to be profitable at a silver price of U.S.$7.50 a troy ounce.

Placer Development of Canada, which manages the property, has 34 per cent of the shares. The Mexican government has the balance through Comision de Fomento Minero and Minera Frisco S.A. de C.V., which each have 33 per cent.

The Fresnillo mine, about 350 miles northwest of Mexico City, was discovered in 1570 and now the same mine is part of Cia. Fresnillo, S.A., the second largest silver producer in Mexico, which increased its company silver output from 200 metric tons in 1980 to 287 metric tons in 1982. Monte Unit, Zimapan, Hidalgo.

The Fresnillo deposits have produced about 6,220 metric tons of silver since 1570. Reserves of silver in ore have been increased since 1980 at the Fresnillo and Naica mines.

Penoles S.A. added 143 tons of silver a year to its capacity in 1983.

Major expansions have taken place at two operations of Mexico's largest corporate silver producer, Industrial Mineral Mexico S.A., the Santa Barbara mine and the San Martin silver-lead-zinc mine to add 40 tons of silver to its annual capacity.

1) Charcas Unit — U.S. $33 million expansion of 2,000 tons per annum, to almost triple capacity.
2) San Martin Unit — U.S. $26 million expansion of 18,000 tons per annum to more than double capacity.
3) Santa Eulalia Unit (phenomenally rich silver ores were found here in the 16th century).
4) Taxco Unit, capacity increased by 50 per cent.

The new U.S. $176 million electrolytic zinc refinery, (114,000 tons of electro zinc and 900 tons of cadmium a year), at San Luis Potosi is to be fed with zinc-silver concentrates.

Amax, U.S.A., (through its wholly owned Rosario Resources Corporation), holds

49 per cent of Rosario Mexico S.A. de C.V.

40 per cent of Cia. Zimapan S.A., Hidalgo — Carrizal Unit

40 per cent of Cia. Fresnillo

14.8 per cent of Guanajuato group of mines, through its Fresnillo holding.

Asarco, U.S.A., through its 34 per cent controlled Mexico Desarollo Industrial Minero S.A. (MEDIMSA), holds interests in a large number of mining operators.

Other Silver-producing mines include:

Cuatro Vetas & Anexas, Minero, Monterrey;
Guanajuato, Minera, Sirena, El Pinquico and Pozos mines, Irapuato, Gto.;
El Orito mine, Real de Asientos & Anexos, S.A.
Campana de Plata, Zacualpan Unit, Cedros mine, Gto.

Santa Ana mine, Restauradora de las Minas de Catorce, San Luis, Potosi.

San Nicolas mine, Culiacan, Sin;
San Javier mine, Son.;
San Juan mine, San Javier, Son.;
Santa Lucia's Cebada and Peregrine Units, Guanajuato.
Minas Nuruapan, Palmarejo, Chihuahua.
Senora Central's Promontorio Mine, Caborca, Son.
Tayahua S.A.'s Terminal Salaverna Unit, Zac.
Trebol's El Porvenir, La Sirena and La Reyna Mines, Guanacevi, Durango.
Victoria Eugenia's Colorada Mine, Chalchihuites, Zacatecas.
Zinc de Mexico S.A. Parral Unit, Chih.;

The El Barqueno prospect near Panico, 355 miles NW of Mexico City, grades 20 g. silver per ton and 5 to 15 g. gold per ton. Probable reserves about 47 metric tons of silver and up to 13 tons of gold, at depths of 90 to 180 feet.

Lacana Mining of Toronto, Ontario, Canada owns 40 per cent of the Encantada Group, which comprises three contiguous mines, the Encantada, Los Angeles and Plomo. Industries Penoles, Mexico's largest mining company, owns 60 per cent of Encantada and manages the mines.

MEXICO — MAIN MINE PRODUCERS OF SILVER

	1981 est. (metric tons)
Penoles Group (Industrias Penoles S.A. de C.V. (produced one third of Mexico's silver in 1981)	
Cia. Fresnillo (worked since 1570), (Amax 40 per cent) (Fresnillo, Naica, Cuale and La Cienega mines)	244
Grupo Guanajuato	135
La Encantada (Lacana, of Toronto, Canada 40 per cent) Ocampo, Coahuila, High grade oxide silver ores discovered in 1982. 4.6 ounces silver per ton. Production cost: U.S.$5.00 an ounce of silver.	46
Cia. Mineral La Negra y Anexas, Negra, Queretaro	35
Campana de Plata S.A., Zacuaplan Unit, Cedros mine, Gto.	18
Minera Mexicana Penoles	14
Cia. Minera la Campana	12
Cia. Zimapan	n.a.
Industrias Penoles, La Minita mine; 1983 was the first year of operation	n.a.
Industrial Minera Mexico (silver output increased in 1983) (second largest silver producer in 1981 — San Martin, Taxco, Santa Barbara, Santa Eulalia and (new) Velardena mines.) Charca expansion tripled output by 1984. Total annual silver production to increase.	341 (684 eventually)
Frisco S.A. de C.V.	
Minera San Francisco del Oro, Chih., (100 per cent) silver-gold-lead-zinc mine in Parral, Chihuahua	66
Minera Lampazos, 68 per cent	47
Real de Angeles, (world's largest open pit silver mine), Zacatecas, effective government control, although it is a joint venture with Placer Development of Vancouver, Canada, which has a 34 per cent interest.	212 (240 in 1983)
Rosario Mexico S.A. de C.V. (Amax, U.S.A. through Rosario Resources Corporation, 49 per cent)	
Rosario Mexico's own Huautla silver-lead mine at Morelos	22
Rosario Mexico also operates:	
Grupo Catorce	93
Cia. de Real del Monte y Pachuca (dates from 1534) (formerly U.S. Smelting, Refining and Mining Co.)	70
Luismin (Minas de San Luis, S.A.) Tayoltita mine, Durango Libertad mine.	76
Neg. Min. Santa Maria de La Paz y Anexas, La Paz, S.L.P.	33
Minerales de Bolanos, Guardalajara, Jalisco	53

MEXICO — MAIN MINE PRODUCERS OF SILVER (Continued)

	1981 est. (metric tons)
Cia. Minera de Cananea; the modern mining town of Cananea, in the State of Sonora, is near the U.S. border south of Tucson, Arizona, (Anaconda, U.S.A., withdrawing participation). The 82,000 tons per annum expansion will be producing from 1985.	14
Mexicana de Avino, Avino mine, Durango, Torreon, Coahuila (Avino Mines and Resources, Vancouver, Canada, 49 per cent). Expansion tripled output by 1983. Reserves of over 4 million tons grade up to 170 g. silver per ton on average.	14 (1983)
Cia. Minera de Minas Nuevas (Terra Mining and Exploration Ltd. of Canada 49 per cent).	
Torres S.A. (Lacana of Toronto, Ontario, Canada 30 per cent; Fresnillo and Penoles 70 per cent).	135
— Las Torres silver-gold complex, Guanajuato, single largest silver-gold mining operation in the world. One of the world's richest silver mines, 7.6 to 10.5 ounces of silver per metric ton. Production cost: U.S.$3.85 an ounce of silver.	
— Cedro Unit	
— Bolanitos Unit	

David Contreras Unit, Encantada S.A., Muzquiz, Coahuila (Penoles 50 per cent; Lacana, Toronto, Canada 40 per cent.)

Preciosa prospect, Durango state, Lacana, Toronto, Canada 40 per cent, Luismin 60 per cent. Lacana evaluating.

At the current rate of extraction, Mexico should once again in 1984 be the world's leading mine producer of silver (with a projected 1,820 metric tons) and exporter. However, the Mexican Energy and Mining Ministry stated that that the country's silver is only expected to increase slightly over the 1983 output of 1,600 to 1,700 metric tons. It could exhaust its silver reserves within the next 18 years, said the President of the Mexican Chamber of Mines in 1983. (Canada's mines produced some 1,204 metric tons in 1982.)

Mexico was apparently leading the world in output of silver in the first quarter of 1984 with 517 metric tons, but monthly output was falling after that time.

Of course, substantial increases in the silver price would create more silver reserves everywhere, including Mexico, as well as encouraging higher world output which would pull the price back.

Mexico's inflation rate, which has been 100 per cent in 1982 and 80 per cent in 1983, remained in the first half of 1984 at 80 per cent. Unemployment and under-employment were above the 50 per cent level, with scant hope of improvement. Mexico's foreign debt of about 90 billion U.S. dollars was the second highest in the world after Brazil. Far more serious would be the major political unrest which some analysts expect will unavoidably develop well before the end of this decade.

Mexico is the world's fourth largest oil producer but, astonishingly, its energy earnings are being used entirely on the payment of interest on its U.S. $91 billion foreign debt. Its public-sector debts were rescheduled and stood at U.S. $48.7 billion in December, 1984. Mexico owes more to U.S. banks, U.S. $26.3 billion at December 31, 1983, than any other country. Next are Brazil $20.7 billion, South Korea $11.5 billion, Venezuela $11.3 billion, Argentina $20.7 billion and Chile $20 billion.

Capital flight from Mexico was very easy until the country imposed exchange controls in mid-1982. Argentina and Venezuela followed in 1983. The Bank for International Settlements estimates that some U.S. $50 billion of capital flowed out of Latin America between 1978 and 1982. U.S. Federal Reserve Board researchers calculate that over one-third of the U.S. $252 billion increase in the debt of Mexico, Brazil, Argentina, Chile and Venezuela between 1974 and 1982 went into buying assets overseas or was salted away in foreign bank accounts. Mexican government statistics suggest that, in total, Mexicans own some U.S. $25 billion worth of property in the U.S.A. and have around $20 billion in U.S. Banks.

Nevertheless, the restrictions on hard currency, such as U.S. and Canadian dollars, make it difficult for mining companies to get spare parts from north of the border, unless they themselves are exporters of silver or other hard currency earning commodities.

Mexico is clearly in its worst economic crisis in 50 years.

Mexico has at least 78 million people. Refugees have poured in from Guatemala and El Salvador; about 90,000 Guatemalans were believed to be in Mexico in 1984.

The U.S. Census Bureau estimates that there are now between 5 million to 7.5 million illegal residents in the U.S.A., (mostly Mexicans), who may hold between 4 million and 6 million jobs in the U.S. Texas has no state law against hiring "illegals".

U.S. government economists report that legal and illegal immigration accounts for almost one-third of total U.S. population growth each year. Immigrants, particularly Hispanics and Asians, add as many as 1 million people a year.

As early as 1990, Hispanics may replace blacks as the U.S.A.'s largest minority group. Hispanics, 60 per cent of whom are Mexicans, are the largest immigrant group in the U.S. currently. Hispanics are now about 10 per cent of the U.S. population but may reach 20 per cent by the year 2000 — in only 15 years time.

The value of the Mexican peso vis-a-vis the U.S. dollar nosedived from 26 to 1 in 1981 to 150 to 1 by end-1983 and about 200 pesos to a dollar by November 1984. The cheap peso is at least attracting tourists from hard currency countries such as the U.S.A. and Canada, (which helps a little), and of course any silver or gold produced can be exported for hard U.S. dollars.

The devaluation of the Mexican peso has the short term effect of lowering local mineral production costs and boosting company profits in pesos. However, the long term effect is the slowing down of mine expansions and development of new projects.

With the constraints on foreign exchange, the lack of investor confidence and the government's dilemma as to which resource developments should get priority, Mexico could otherwise theoretically increase mine output to 2,200 metric tons of silver a year.

As it is, Mexico was reported early in 1984 as intending to achieve such an increase in its total annual silver output, of some 30 per cent, (500 tons), but that is easier said than done. Some observers believed that Mexico's mine output of silver was actually going to rise in 1984.

MEXICO – SILVER OUTPUT OF SOME MINES (metric tons)

	1979	**1980**	**1981**	**1982**	**1983**
Campana De Plata, S.A.	24.6	17.9	n.a.	n.a.	n.a.
Cia Fresnillo, S.A.	224.8	217.1	243.6	267.5	286.6
Cia Minera La Campana, S.A.	11.8	11.9	n.a.	n.a.	n.a.
Cia Minera La Negra Y Anexas, S.A.	34.1	35.3	n.a.	n.a.	n.a.
Compania De Real Del Monte Y Pachuca	n.a.	62.4	70.0	75.2	71.8
Compania Minera De Cananea, S.A.	17.5	20.1	14.4	13.7	12.5
Grup Guanajuato	156.2	130.5	n.a.	n.a.	128.5
Industrial Minera Mexico, S.A.	542.8	525.2	450.5	417.7	501.3
La Encantada, S.A.	48.7	40.8	n.a.	n.a.	n.a.
Minas De San Luis, S.A.	n.a.	64.8	76.2	80.8	71.4
Minera Mexicana Penoles, S.A.	12.5	14.1	n.a.	n.a.	n.a.
Minera San Francisco Del Oro, S.A. De C.V.	81.1	81.1	66.2	86.2	90.7
Negociacion Minera Santa Maria De La Paz Y Anexas, S.A.	31.7	32.8	n.a.	n.a.	37.3

Source: American Bureau of Metal Statistics Inc.

MEXICO SILVER PROJECTS

Project	Location	Proven Reserves	Grades	Probable Reserves	Grades	Status
Tizapa	Zacazonapan			2 million metric tons; 7 million possible	271 g. Ag per metric ton, pluc Au, Pb, Zn, Cu & Cd	Planned 350,000 metric tons a year
La Esmerelda (an extension) of Tizapa)	Zacazonapan			120,000 metric tons	190 g. Ag per metric ton	
Taviche	El Cubilte mine	170,000 metric tons	171 g. Ag per metric ton			Feasibility study not yet finished
Silver Prospect	San Luis Potosi State	1.2 million metric tons	163g. Ag per metric ton plus Au, Pb, Zn			
Silver Prospect	Parral, Chihuahua State			120,000 metric tons	490 g. Ag per metric ton, 3 per cent lead	
3 deposits	Durango state, Inde	162,000 metric tons	328 g. Ag per metric ton plus Au, Pb, Zn	130,000 tons	similar grades	
3 deposits	El Triunfo, Baja California	55,770 metric tons	276 g. Ag per metric ton			
	Tahuehueto Durango	210,000 metric tons	145 g. Ag per metric ton	258,000	similar grades	

MEXICO SILVER PROJECTS (Continued)

Project	Location	Proven Reserves	Grades	Probable Reserves	Grades	Status
Silver Deposit	La Catarina 100-150 miles west of Guadalajara, Jalisco State	230,000 metric tons	167 to 178 g. Ag per metric ton, 3.4 percent lead			
Gold and Silver Prospect	El Barqueno, Central Mexico near Panico. Motherlode 3 miles long, 400 feet wide 355 miles NW of Mexico City.	?	?	About 47 metric tons of silver and 13 tons of gold. Depths of 90 to 180 feet.	20 g. silver per ton; 5 to 15 g. gold per ton.	

5.3.3 SOVIET UNION

The Soviet Union probably produces about 13 per cent of total world output of silver.

SOVIET METAL OUTPUT OF SILVER, INCLUDING SECONDARY

(metric tons)

1977	1978	1979	1980	1981	1982	1983	1984*
1,400	1,431	1,431	1,431	1,446	1,458	1,465	1,630

*Silver Institute estimate.

Source: U.S. Bureau of Mines estimates, 1977 through 1983.

The world's second or third largest mine producer of silver is presumed to be the Soviet Union — if you assume that it produces about 1,500 metric tons of silver a year. The U.S. Bureau of Mines says 1,465 metric tons for 1983. Who really knows?

We do know this. Silver is almost the only "strategic" type of metal that the U.S.S.R. does not have in superabundance. J. Aron said that the Soviet Bloc had a deficiency of as much as 217 metric tons of silver in 1981. Since then, the U.S.S.R. has been a net buyer of silver on the Western world markets and was again reported buying silver in 1983.

An illustration of this is the fact that the Soviet Union imported from the West about 600 metric tons of silver in 1983 in addition to large exports of silver to the Soviet Union from Poland etc. Soviet imports of silver in 1982 from the West were an estimated 653 metric tons; J. Aron.

SOVIET NET IMPORT RELIANCE ON SELECTED MINERALS AND METALS AS A PERCENTAGE OF SOVIET CONSUMPTION IN 1983

	Estimated (U.S.B. of M.) Per Cent of Consumption	Principal Sources
SILVER	10	Switzerland, U.K. (bullion dealers), Poland, North Korea
Fluorspar	54	China, Mongolia, Thailand
Bismuth	50	Japan
Bauxite and Alumina	48	Greece, Guinea, Hungary, India, Jamaica, Yugoslavia
Cobalt	47	Cuba
Tungsten	43	China, Mongolia

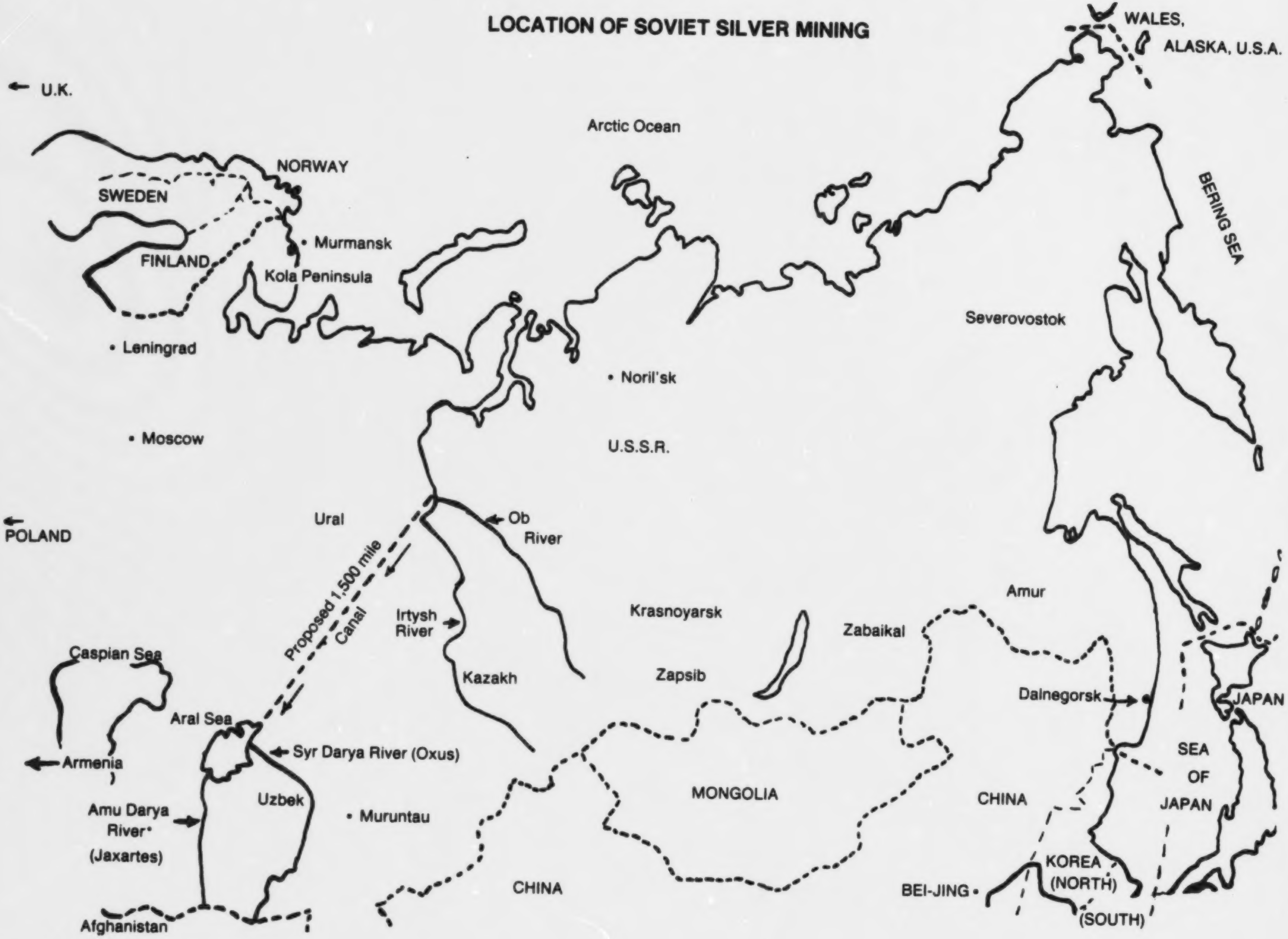
Source: U.S. Bureau of Mines estimates

This silver situation is not new for Russia. It existed 270 years ago.

In his "Peter the Great — His Life and World", Robert K. Massie, Rhodes Scholar, (an endowment from mining), says that in 1714 Tsar Peter forbade the export of silver, to preserve the nation's economy.

The mines of Russia were simply not producing enough silver or gold and Peter was forced to allow the debasement of his new rouble coinage which became defective both as to alloy and weight of metal. Both the nobility and the peasants had hoarded the good (higher purity) coins — an ancient habit and a wise one — not confined to Russia, fortunately.

LOCATION OF SOVIET SILVER MINING


WALES,
ALASKA, U.S.A.
U.K.
Arctic Ocean
BERING SEA
NORWAY
SWEDEN
Murmansk
FINLAND
Kola Peninsula
Severovostok
Leningrad
Noril'sk
Moscow
U.S.S.R.
Ural
Ob
River
POLAND
Proposed 1,500 mile
Canal
Amur
Irtysh
River
Krasnoyarsk
Zabaikal
Caspian Sea
Kazakh
Zapsib
Dalnegorsk
JAPAN
Aral Sea
Syr Darya River (Oxus)
SEA
OF
JAPAN
Armenia
MONGOLIA
CHINA
Uzbek
Amu Darya
River
(Jaxartes)
Muruntau
KOREA
(NORTH)
BEI-JING
CHINA
(SOUTH)
Afghanistan

In 1718, merchants leaving Russia were searched for any silver or gold coins and any found were confiscated.

The death penalty for anyone caught exporting silver from Russia was introduced in 1723.

The import of silver and gold into Russia was vigorously encouraged and there was no duty on them.

Another matter with a familiar ring today is that when Russians sold their goods to foreigners, they were not permitted to accept Russian money in payment but always had to receive foreign money. This is still basically true in 1985.

Ironically, Russia's great rival in the Baltic, Sweden, (which in 1700 owned what are now the Esthonian and Latvian republics, now controlled by the Soviet Union, plus the area on which Leningrad is built), was a major exporter of silver, copper and iron. It still is.

The Swedish territories of Livonia (roughly Latvia), Esthonia and Ingria, and the coastal territory between Esthonia and the border of Finland (then Swedish) surrounding St. Petersburg, (Leningrad), the city which Tsar Peter had started to build in 1703 at the mouth of the river Neva, (Finnish for swamp), in what was technically Swedish territory, were ceded in perpetuity to Russia in September, 1721.

This treaty was largely the result of the devastating raids on Sweden's homeland east coast by Russian troops under Peter's Irish general Count Lacy earlier that year and in 1719. Born in County Limerick in 1678, he was one of the most famous generals of the 18th Century.

In 1932, the Soviets instituted a campaign to gather in all silver held by the people in the form of coins, ornaments etc. They were paid in paper roubles.

Silver is serebro in Russian. There are many places with names such as Serebrovo, east of Krasnoyarsk, Serebryanka in Kazakhstan, Serebryanka river and town in the Urals, Serebranoye, NE of Omsk and Serebryanye Prudy, SSE of Moscow.

Consumption of silver by the 275 million people of the Soviet Union today is very considerable, with growing demands in the photographic, electronic and armaments industries. There is a shortage of (silver-bearing) X-ray film, as well as surgical instruments and even aspirin. One observer goes so far as to point out that there are as many as seven so-called wars of liberation or struggles going on in the Soviet empire, the nine years in Angola, Kampuchea (Cambodia), Laos, Vietnam, Ethiopia, Mozambique and Nicaragua, as well as the five year war in Afghanistan, requiring large quantities of Soviet arms. The 5-year Afghan War is now costing the Soviet Union the equivalent of over 6 billion dollars (U.S.) a year, with at least 140,000 troops still tied down.

In the early 1980's Peru overtook Mexico and the Soviet Union to become the world's largest mine producer of silver. The Soviet Union has been assumed by many to be first in the years since 1974, (when Canada last led), except for 1978 and 1981 when Mexico exceeded the estimated Soviet level.

The Soviet Union obtains its domestic newly mined silver mainly from lead-zinc-copper mines in Armenia, Kazakhstan, the Urals and the Soviet Far East, and from nickel-copper mines at Noril'sk and the Kola Peninsula. For a long time, the Urals were the major producer of silver, (and gold) in Russia, but in the Soviet period, the region has been far surpassed by the Soviet Far East, Central Asia and the Caucasus. Silver is mined in the North Caucasus Region, the Transcaucasus-Armenia, eastern Kazakhstan, Turkmenistan, Uzbekistan, Western Siberia at the Salair Ridge, Noril'sk, the Kola Peninsula, and the formerly Chinese Sikhote-Alin mountains, (along the coast of the Sea of Japan, opposite Hokkaido, Japan), where the lead smelter at Tetyukhe, (now renamed Dalnegorsk, "far mountain"), produces some silver.

The strategic centre of Soviet naval power has shifted from the Leningrad military district to the Murmansk area. 70 per cent of all nuclear-carrying vessels of the Soviet Navy are stationed at Murmansk, their vital major ice-free port in the silver-rich Kola peninsula (close to Norway) which is swarming with defensive missiles, tanks, rockets etc. In 1968, during the Czech crisis, 200 Soviet tanks drove up to the 125 mile long Norwegian border there and trained their guns on Norway, the most vulnerable NATO country, without explanation.

More silver output is expected from the Noril'sk-Taymyr nickel-copper mines and from similar mines in the Kola Peninsula. The Urals ores may contain up to 0.4 g. of silver per metric ton.

Soviet mine output of silver is thought to be only about 1,500 metric tons a year and is targeted at about 1,550 tons in 1985. Virtually all of it arises as a by-product of non-ferrous base metal mining operations. A few gold treatment plants recover a relatively small amount of silver, too. 14 gold refineries were said to be producing some silver.

The head of the All-Union gold association, Soyuzzoloto, which administers the production in the U.S.S.R. of gold, silver and platinum group metal mines, was relieved of his duties in 1983 "for serious shortcomings in his work".

One aspect of the "shortcomings" is that the rate of recovery of silver from polymetallic ores has averaged only about 76 per cent at Soviet metallurgical plants. The rate of recovery of silver in individual plants ranged from 89 to 92 per cent at the Belousovskaya, Zyryanovskaya and Tsentralnaya plants to only 23 per cent at the Koksuyskaya plant, according to Tsvetnye Metally (Non-Ferrous Metals), Moscow, No. 2, February 1983, pp. 82, 83.

However, the Soviet union is estimated to have the world's largest mineable reserves of silver in ore in the ground — the same figure as that for Canada — 50,000 metric tons. In both cases, of course, the bulk of the reserves are imprisoned in base metal deposits, often at great depth.

In the Soviet 11th 5-year plan (1981-85), the total mine output of nickel is aimed at an increase of 30 per cent by the end of the five years and this may increase the by-production of silver by a similar percentage.

It is also clear that increasing the Soviet mine supply must be extremely difficult if their plans are to raise it from about 1,450 metric tons of silver in 1982 to only about 1,550 tons in 1985 and if their mine production of silver is aimed at achieving only an overall 4 per cent increase during the five years up to the end of 1985, when viewed against their chronic silver shortfall in most years.

Of course, it does not follow that increasing nickel output by 30 per cent will yield anything like that percentage increase in silver by-product or of the gold or platinum group metals by-product, because of the unknown contents of the ores to be mined, but there will be some increase in the output of silver and the other precious metals, one must assume.

The ambitious expansion at Noril'sk-Taymyr has been greatly assisted by the 1982 completion of a new shaft at the Taymyr nickel-copper mine near Talnakh. It is the deepest vertical shaft in the Soviet Union, over 5,000 feet deep. Of the six shafts planned at the mine, only the last one was incomplete in 1983.

Full production at the Taymyr mine in northwestern Siberia appears imminent.

Clearly, even the helpful imports of silver into the Soviet union from Poland, (greatly reduced in recent years because of output problems resulting from the Solidarity activities), have not been enough to satisfy total Soviet demand for silver. A normal year in Poland produces about 650 metric tons of silver, but in the Solidarity years, it may have fallen to 450 tons.

In spite of all this, the Soviet Union is quietly accumulating silver in its stockpile, according to Paul Sarnoff.

There is a growing scarcity of zinc in the Soviet Union just as there is of silver and substitutes are sought in certain uses. Meanwhile, the 1981-85 Plan calls for zinc and lead mine output to increase by 12.7 per cent and 12 per cent respectively in Kazakhstan, the major source, so that those increases, if achieved, may produce more by-product silver. However, the 1983 Plan portion for zinc-lead was not fulfilled, reportedly.

The Soviet Union also purchases copper from the West on occasion. During World War II, the USSR had an inadequate supply of copper and sulphur and lacked nickel, antimony and rubber, in contrast to an abundant supply of most other materials, so the copper shortfall appears to be chronic.

Inter alia, copper is needed for general armament and all electrical equipment; sulphur for explosives.

Although it is estimated that there were no net imports of East Bloc silver by the West in 1982 and 1983, Metals Analysis and Outlook forecast that there will be such net imports by the West of about 150 metric tons in 1984. Combined sales by the U.S.S.R., Poland and Korea are likely to amount to 598 metric tons in 1984, or 45 per cent less than in 1983, according to Credit Suisse.

One might mention here that the Soviet share of world mine output of gold is expected by some experienced observers to fall to 19.2 per cent in 1985, compared to 19.9 per cent forecast for 1984 and the pattern for silver may be quite similar. Since the U.S.S.R. greatly restricted imports of essential raw materials and equipment to a minimum in 1982 and 1983, a more flexibile or more liberal policy may have to be introduced in the near future, causing increased exports of gold, diamonds etc. to pay for such necessary imports, including vital grain and silver in 1984, 1985 etc.

During the 1983/84 crop year, the Soviet Union purchased about 33 million tons from the Western World but 50 million tons may have to be imported in 1984/85 at an estimated cost of U.S. $8 billion. The grain year ends on June 30. Two million tons of wheat in this figure may come from India. The 1983 Soviet crop was only about 195 million metric tons and Soviet imports in 1983/84 were 33 million tons of grain.

Soviet grain consumption is about 220 million tons a year, it is believed.

Once again, in 1984, the Soviet grain crop was disastrous — expected to total less than 170 million metric tons, nearly 70 million tons below the yearly target under the 1981-85 5-Year Plan and over 25 per cent below the specific 1984 target of 240 million tons. This is far worse than the U.S.S.R. grain output in the mid-1970's.

It is the fifth straight year of poor harvests in the Soviet Union, 1980, 1981, 1982, 1983 and 1984. 1983 Soviet grain output was 195 million tons.

Soviet grain is said to be produced by 35 per cent of the U.S.S.R. population of more than 275 million people. In contrast, Canada's grain harvest of about 40 million metric tons (some of which will go to the Soviet Union) was produced by about 5 per cent of Canada's 25 million population, i.e. about 1.25 million Canadian workers on grain, compared to around 22.65 million Soviets to produce an equivalent 40 million tons of grain, (1984).

The Soviet Union brought in a poor 1984 grain harvest from Kazakhstan, one of its main growing areas, following a long drought there. Drought and hot weather also reduced the grain crop in the Volga Basin, the Urals and the north Caucasus. Heavy rain in the Ukraine slowed harvesting and spoiled the cut crop.

Hard currencies of certain Western countries are badly needed by the U.S.S.R. to purchase the large quantities of grain, some silver and Western equipment that have to be imported by the Soviets to make up the deficit of supply against their consumption, e.g. at least 10 million tons of grain in the few months immediately following the poor 1984 harvest, part of the 50 million tons costing U.S. $8 billion which the Soviets will probably need to import in the winter and spring of 1984-85.

This 1984-85 grain situation is generally bearish for the silver price in its effects.

Since total Soviet grain imports in 1984-85 will have to be a record 50 million metric tons, compared to 33 million tons imported in 1983-84, the U.S.S.R. has to export materials to obtain hard currency to pay for it.

This need to import vital supplies usually makes the Soviets eager sellers of gold, diamonds, palladium etc. and this in turn weakens the price of silver. 1984 Soviet exports of diamonds have increased heavily because the USSR needs hard Western currencies to buy grain after the poor harvest. In the first 9 months, their diamond sales reached U.S. $160 million and to move that amount, the Soviets sold the diamonds at 5 to 10 per cent below market value which, in turn, pulled the diamond market price down further. This acts to worsen South Africa's situation.

Put rather simply, good Soviet harvests are good for the gold and silver price and bad Soviet harvests are bad for the gold and silver price.

SOVIET NET EXPORTS OF SELECTED MINERALS AND METALS AS A PERCENTAGE OF SOVIET CONSUMPTION IN 1983

	Per Cent of Soviet Consumption (estimated)
Gem Diamonds	375
Platinum Group Metals	65
Gold	29
Nickel, smelter production	28
Aluminum	44

5.3.4 U.S.A.

Silver mines were operating before 1620 in what are now the States of New Mexico, California and Arizona.

The United States became a large silver producer in 1860. Development of the phenomenal Comstock Lode in Nevada flooded the world market with silver. For the next 30 years, the U.S. had the world's largest mine output of silver.

Over eighty per cent of current U.S. mine production of silver is in Idaho, Arizona, Colorado and Montana.

MAJOR UNITED STATES SILVER PRODUCING MINES, 1981

(*) indicates bulk minable lode deposit. Modified from Drake (1981) by S.W. Ivosevic.

****Rank Mine (1981)**	**County**	**State**	**Principal Metal Product(s)**
1. Sunshine	Shoshone	Idaho	Silver
2. Galena	Shoshone	Idaho	Silver
3. Coeur	Shoshone	Idaho	Silver
4. Lucky Friday	Shoshone	Idaho	Silver
5. Utah Copper	Salt Lake	Utah	Copper*
6. Berkeley Pit	Silver Bow	Montana	Copper*
7. Candelaria Silver	Mineral	Nevada	Silver*
8. Delamar Silver	Owyhee	Idaho	Silver-gold*
9. Bulldog Mountain	Mineral	Colorado	Silver
10. Twin Buttes	Pima	Arizona	Copper*
11. Tyrone	Grant	New Mexico	Copper*
12. Bunker Hill	Shoshone	Idaho	Zinc-silver-lead
13. Star	Shoshone	Idaho	Silver-lead-zinc
14. Sierrita	Pima	Arizona	Copper*
15. Troy	Lincoln	Montana	Silver-copper*
16. Morenci	Greenlee	Arizona	Copper*
17. Sherman Tunnel	Lake	Colorado	Silver-lead
18. Eisenhower	Pima	Arizona	Copper*
19. Taylor	White Pine	Nevada	Silver*
20. Magma	Pinal	Arizona	Copper
21. Buick	Iron	Missouri	Lead*
22. San Manuel	Pinal	Arizona	Copper*
23. Mission	Pima	Arizona	Copper*
24. Bagdad	Yavapai	Arizona	Copper
25. Crescent	Shoshone	Idaho	Silver

** This ranking had changed by 1984, as later paragraphs indicate.

The United States was the world's fifth largest mine producer of silver in 1983 with 1,250 metric tons, but should be the number four producer in the years 1984 through 1986 if all plans develop.

Unlike many other countries where silver is largely a by-product of base metal mining, up to 65 per cent of the silver mined in the U.S. is obtained from primary silver mines, largely in Idaho, depending on the year. Typically, in the U.S. one must go down as far as 5,000 to 9,000 feet to recover the silver. Mining costs are high. As the old Spanish proverb says: IT TAKES A GOLD MINE TO RUN A SILVER ONE." In any case, as of early 1984, sixteen of the 25 copper producing mines were closed.

In fact, the last 10 years have seen a decline in the relative importance of U.S. mine production of silver in world total output.

Since about half of the U.S. silver is not usually mined by itself, but is a by-product of base metal mining, low prices of silver and base metals made life very difficult for a number of U.S. mine producers in 1981-82. Many mines cut back output or closed completely or temporarily, e.g. in the U.S.A., the Gooseberry mine in Nevada, the Candelaria, Duval, Hecla's Star and Consolidated Silver, Kennecott, Bunker Hill, Magma, etc., with a resulting loss totalling well over 220 metric tons of U.S.-mined silver a year. Further, one of the largest U.S. silver mines, Sunshine Mining at Kellogg, Idaho, suspended production temporarily in June, 1982. Its 1981 output was 128.75 metric tons of silver.

In 1983, silver was produced at more than 170 mines in 17 states, of which 10 mines provided 65 per cent of total output.

Mining companies that produce both silver and gold include Coeur, Newman and Pegasus, as well as Homestake (about 62 metric tons of silver a year).

U.S. total gold output could reach 200 tons a year by 1999, 14 years from now, making it the third largest gold producer in the world after South Africa and the Soviet Union, ousting Canada.

Silver output increased in 1983 at mines like the Lucky Friday and the Sunshine.

U.S. mine production of primary silver, which made it fifth in the world in 1983, continued an upward trend in 1984.

Total U.S. mine production of silver in 1983 was valued at U.S. $483 million.

The 1984 merger of Hecla Mining Company of Wallace, Idaho with Ranchers Exploration and Development Corporation, Albuquerque, New Mexico, and its new Escalante mine in Utah, which itself produced about 73 metric tons of silver in the year ending June 30, 1983, makes the resulting firm the leading corporate mine producer of silver in the U.S.A., with a total output of perhaps 290 metric tons of silver a year. The former Hecla company produced about 211 metric tons of silver 1983.

U.S.A.: PRIMARY AND SECONDARY SILVER SUPPLIES, 1979-83

	1979	1980	1981	1982	1983 est.	1984 est.
Silver (mines)	1,185	974	1,260	1,250	1,300	1,449
Silver (secondary)	1,180	1,650	1,210	843	1,090	n.a.
Total	2,365	2,624	2,470	2,093	2,390	n.a.

Sources: U.S. Government 1979 through 1983. Silver Institute 1984.

In 1984, Hecla's "Lucky Friday mine", the leading U.S. silver producing mine in 1983, with its U.S. $40 million second shaft and increased production, (without Ranchers), should be the top U.S. mine producer of silver at about 165 metric tons a year; second, Sunshine at around 140 metric tons, (128 metric tons of silver in 1981); third, the Troy mine in Montana some 131 metric tons; fourth, Galena mine about 118 metric tons, with Coeur d'Alene fifth around 78 metric tons.

Asarco is the second largest U.S. corporate producer through its ownership of the Galena mine and as operator of the Coeur mine. Asarco also operates the American Silver project abutting the Coeur and is driving underground to the so-called Wire Vein with 1985 as their target for completion. Asarco's total silver output was 320 metric tons in 1981.

Callahan Mining Co. receives 50 per cent of the cash flow from the Galena mine and 5 per cent of the profits of the adjacent Coeur silver mine in the Coeur d'Alene area of Idaho. Both are operated by Asarco.

The Galena mine ranks fourth in the U.S. and Coeur fifth.

Sunshine has the largest known silver ore body in the U.S. and is America's all-time leading mine producing silver, on a cumulative basis. Sunshine Mining Company of Dallas, (with a new operations office in Boise, Idaho), is a large corporate mine producer of silver in the U.S. and produced 128 metric tons of silver in 1982 and 137 tons in 1983. Its profits were U.S. $5.5 million in 1983 after net losses in 1980, 1981 and 1982. Its silver production capacity will increase by about 20 per cent following the acquisition of all of Hecla's interest in the Sunshine Unit Area and has increased its proven and probable reserves of silver ore by more than 25 per cent.

In mid-1984, it was holding back from the market a monthly output of over 3 tons of silver and a little gold, owing to the low prices since January, 1984. Its stockpile of silver, about 16 metric tons in August, 1984, was still growing. Pegasus Gold was also keeping its silver output off the market.

Some of the silver mines in the U.S. that are new and some that have reopened or expanded since 1980 are:

1) "Sixteen-to-One" Mine, Silver Peak, Esmeralda County, Nevada, (Sunshine Mining).

   Gold-silver ore

   Came on stream February, 1982
   Output: about 30 metric tons of silver a year.

2) Sunshine Mine, Shoshone County
   Second largest silver mine in the U.S.

   Reopened end-1982; full production by late February 1983. Output in 1983 about 150 metric tons of silver contained. Two thirds of the output was being stockpiled during the first half of 1984. First quarter 1984 loss was U.S. $102 million.

   High direct production costs — about U.S. $7.50 an ounce in April, 1984.

   Acquisition of the Hecla interest in the Sunshine Unit Area in 1984 should help output.

3) Review Mine, Arizona
   - came on stream in 1983
   - expected output: up to 45 metric tons of silver a year.

4) Candelaria Mine, Hawthorne, Nevada
   - reopened early 1984
   - output should be 55 metric tons of silver a year.

5) Deer Trail Mine
   - reopened after 35 years by Canadian developers
   - output about 30 metric tons of silver a year
   - the concentrate goes to Cominco, British Columbia, Canada for refining.

6) Escalante Mine, Utah
   - 1983 output was double that of 1982, standing now at over 70 metric tons of silver a year.

7) Sunnyside Mine, Silverton, Colorado
   - expanded 1983 output by 10 metric tons of silver.

8) Troy Unit, Montana (Asarco) — for a time, in 1982, the single largest silver mine in the U.S.

Compare the total of this new output to the loss of over 220 metric tons (mentioned above) annually through those 1982-3 U.S. mine closings and cutbacks before Sunshine's important 130 tons of silver per annum approximately was also cut off (which did not affect their mine called "16-to-1".)

Of course, the silver market itself is basically indifferent to the opening or closing of individual mines, or to mining cost problems, as long as the overall supply and demand balance is not too dramatically disturbed, (as is the case in the small net loss of only two hundred metric tons or so a year in the U.S. mine output shown above, offset to some extent by new production elsewhere in the country).

Recovery of silver from tailings on surface at closed mines is profitable at U.S. $9 or over at places like the old Alvarado mine.

IDAHO — THE GEM STATE

Produces more newly mined silver by far than any other state — over 40 per cent of the silver from U.S. mines.

Up to half of the total U.S. mine output of silver comes from silver mines per se in Idaho. Depths approach 7,000 feet. The largest U.S. silver producing mines, Lucky Friday, Hecla and Galena, Asarco, as well as some in the next largest group, Coeur, Asarco and the Sunshine mine, are in Idaho.

Since mining began in the early 1880's, some 29,000 metric tons of silver have been mined in the Coeur d'Alene district through 1980. It is still the richest silver district in the U.S.A. after 100 years of output.

One interesting story is that of Patrick (Patsy) F. Clark. He was an Irish immigrant who moved to Spokane, Washington in 1887 to seek his fortune in the nearby silver mining district of Coeur d'Alene in northern Idaho. Within a few years be became one of the richest men in the Northwest U.S. His properties stretched from British Columbia, Canada to Mexico. He built a fabulous mansion home at Spokane, with cost no object, to signify to the city elite his achievements in life. It now incorporates an elegant restaurant.

The leading U.S. silver producing mines in 1984 include:

1) Lucky Friday, Hecla, silver output up 35 per cent from 1981. Profits from the Radon uranium mine near Moab, Utah enabled Hecla to buy into the Lucky Friday silver-lead-zinc mine, now wholly owned.
2) Sunshine mine. The new U.S.$18 million silver refinery of Sunshine Mining will be completed in late 1984.
3) Troy, Montana
4) Galena, Callahan Mining is the owner; Asarco the operator
5) Coeur mine, Asarco, 50 per cent, Coeur d'Alene Mines 40 per cent, Callahan and Hecla each 5 per cent
6) De Lamar; Earth Resources 52.5 per cent; Superior Oil and Canadian Superior Oil 47.5 per cent
7) Bunker Hill
8) 16-to-1, Sunshine
9) Crescent, Bunker Hill. (has a mill-head grade of up to 33 ounces of silver).

The Coeur mine had production costs averaging U.S.$4.75 an ounce in 1983. It is the *fifth* largest silver producing mine in the U.S. with 80 metric tons of silver a year. Grade 20.7 ounces silver per ton.

The Sunshine mine, discovered by two farm boys from Maine in 1884, (with its "16 to 1" mine in Nevada), had direct production costs of U.S.$7.50 an ounce in 1983; Production: 137 metric tons of silver. Its new metals refinery at Big Creek near the Sunshine silver mine, completed by November, 1984, will be at full production during the first quarter of 1985 and have a capacity of about 250 metric tons of silver a year from its own mines and from others.

Sunshine's stockpile of silver, about 16 metric tons in August, 1984, was still growing. (This and that of Pegasus Gold, Montana will show up in mine production statistics, but one should remember that it is not yet on the market.)

The Delamar Silver mine, (Superior Oil and Canadian Superior Oil 47.5 per cent), is in De Lamar district, Owyhee County in Idaho.

Callahan Mining has an 82.3 per cent interest in and has under way a 6-year U.S.$26.6 million 5,100 foot deep shaft silver project which will be completed in 1985. It is at the Caladay property adjacent to the city of Wallace and the Galena mine. The Blackstone mine of Circa Inc. has a mineralized zone containing 20 to 28 ounces of silver per short ton.

The Treasure Vault property under development by Big Turtle Mines has grade of 7.38 ounces of silver per metric ton.

Arizona

Arizona, ("Silver Bearing"), State in the southwest United States, takes its name from an Aztec Indian word "arizuma", meaning "silver-bearing". It is the second largest mine producer of silver, after Idaho, in the U.S., with some 20 per cent of the national output.

In the late 1500's Indians led Spanish explorers to mines in what is now northern Arizona. In the 1600's and 1700's, the Spanish discovered and mined silver and gold adjacent to the Santa Cruz river, south of present day Tucson.

The leading silver-producing mines in Arizona are:

1) Twin Buttes, (Anamax)*
2) Mission, (Asarco)
3) Superior, (Newmont)
4) San Manuel, (Newmont)
5) Eisenhower, (Anamax)*
6) San Xavier, (Asarco)
7) Sacaton, (Asarco)

8) Sierrita, (Duval)
9) Morenci, (Phelps Dodge)
10) Magma
11) Bagdad, (Cyprus Bagdad)

*Anaconda (Atlantic Richfield) is endeavouring to divest itself of its 50 per cent interest in Anamax (Amax has the other 50 per cent) under an F.T.C. consent order.

The Ajo mine produces silver; smelter closed April, 1982 to May, 1984.

The Mystic silver-gold mine came on stream in the summer of 1984.

Silver District Properties prospect of Orbex Minerals has a grade of 5.5 ounces per metric ton for the initial mining stage.

Colorado

The third largest mine producer of silver in the U.S.

The leading silver-producing mines in Colorado in 1981, were:

1) Sherman Tunnel, Hecla. On September 14, 1984, production ceased at Sherman, because of the low silver price and the poor lead market.
2) Bulldog Mountain, Homestake
3) Resurrection, Newmont
4) Leadville, Asarco
5) Silverton Mine

The Bulldog mine at Creede is the silver producer in the Homestake group, contributing 6 per cent of earnings.

The Idarado mine produces some silver.

The North American Power Petroleum's rehabilitated Caribou silver mine is expected to start up later in 1984. Grade is 30.8 ounces of silver per metric ton. Concentrate will go to Cominco's Trail smelter in British Columbia, Canada.

The Cash prospect of Cosmos Resources grades 11.33 ounces of silver per metric ton.

The Camp Bird mine in Colorado is expected to yield about 15.5 metric tons of silver and half a ton of gold a year.

Montana — The Treasure State

The State of Montana has the motto "oro y plata", Spanish for "gold and silver". It ranks as the fourth largest mine producer of silver in the U.S.A., but had until recently the single largest silver producing mine in the country, Asarco's Troy.

The leading silver-producing mines in Montana are:

1) Troy Unit, Asarco, Lincoln County.
   Troy opened in November, 1981. Troy's output is about 135 metric tons of silver a year (the single largest U.S. mine producer of silver in 1982, second largest in 1983, should be third largest in 1984).
2) Berkeley Pit, Anaconda
3) Golden Sunlight, Placer Development, Vancouver, British Columbia, Canada. U.S.$50 million open pit mine, on stream February, 1983. Output: 3.1 metric tons of gold, (with some silver), are expected in both 1984 and 1985. The doré assays about 75 per cent gold; 15 per cent silver, balance mainly copper.

There is an area some fifteen miles southeast of the Troy mine in Montana called Rock Creek which could one day constitute a very large development of low grade ore but a very sizeable output of silver. Environmental etc. concerns are a problem however. Rock Creek is potentially richer than Troy, which grades 1.5 ounces of silver per ton.

Hog Heaven, a project of Denver-based CoCa Mines in Flathead County in Western Montana requiring some U.S.$30 million delayed construction start-up. The cut off grade is 2.2 ounces per metric ton for the first two years. Output could be 47 to 93 metric tons of silver a year, with an initial rate of 64 tons of silver per annum and 0.1 metric ton of gold.

Pegasus Gold of Vancouver, Canada, in the first half of 1984, produced silver in north central Montana at an annual rate of 0.11 metric ton and their silver stockpile at end June, 1984, was reportedly about 11.4 metric tons of silver, up from 9.67 metric tons at end 1983.

Utah

the fifth largest mine producer of silver of the U.S. States.

1) Utah Copper, Kennecott, was the major mine producer of silver in the state in 1981.
2) New (1980) U.S.$20 million Escalante Mine, Hecla/Ranchers Exploration and Development Southwestern Utah, near the Nevada state line, 42 miles west of Cedar City, Utah. Output about 75 tons of silver a year. In April, 1984, Sunshine Mining offered U.S.$197 million for Ranchers so as to acquire the Escalante mine but later agreed to withdraw. The new arrangement results in Sunshine owing 2.5 per cent of Hecla's stock and Hecla owning 8.5 to 9 per cent of Sunshine. Hecla transferred its interest in the Sunshine Unit Area to Sunshine. Hecla offered $189 million. The silver output of Hecla plus Ranchers, about 280 metric tons or more of silver a year, (bullion 95 per cent silver purity), will be higher than Asarco's world wide output of silver, the former corporate leader. (Sunshine plus Ranchers would have produced about the same amount of silver as Hecla without Ranchers).
3) In April, 1984, Getty Minerals started up the Mercur open pit mine, the largest primary gold mine in the State. It should produce about 0.3 metric ton of silver a year in doré.

Nevada

Nevada is known as the "Silver State", but it is now only a small mine producer of silver in the U.S.A., but there are several new silver prospects.

IT IS THE LARGEST GOLD-PRODUCING STATE.

Silver is recovered from some of the gold ores.

The fabulous Comstock silver discovery of the mid-19th century made Nevada famous, helped to finance the North in the Civil War and made the U.S.A. dominant in silver for decades.

The leading Nevada silver-producing mines in 1981 were:

1) Candelaria Silver Properties mine, (100 per cent Nerco Minerals) Mineral County, Hawthorne, Nevada — was the largest new silver mine in the U.S. in 1980 — inactivated temporarily in 1982; re-opened early 1984. Output should be 55 metric tons of silver a year.
2) Taylor, 14 miles southeast of Ely, started up in 1981. Silver King Mines Inc., operator, 50 per cent interest and Nerco Minerals Co. 50 per cent. Production: 30 metric tons of silver a year, approximately. Silver King's Ward Mountain silver project may start output late in 1986.
3) The new "Sixteen-to-One" (16:1) gold-silver mine grades at some 6 to 7 troy ounces of silver per short ton. The cost to Sunshine has been U.S.$34.8 million. It produces up to 37 metric tons of silver a year. The new mill produces over 30 metric tons of silver a year.

The Pinson open pit mine of Lacana, Toronto, Canada and partners Rayrock and Siscoe Metals, has a lode of about 3 million tons, with a grade of 0.093 ounce of gold per ton, plus 2.3 million tons of up to 0.04 ounces per ton, (which would mean mining 25 tons of ore to produce 1 ounce of gold). It produces about 1.6 metric tons of gold a year. Production cost: U.S.$196 per ounce of gold.

The Gardnerville, Nevada silver property, mine and mill, has been purchased by Twentieth Century, with Veta Grande Co. retaining 20 per cent of the profits and developing the property.

The Rio Sierra Silver Corporation's Nevada Park silver property may eventually produce 15.5 metric tons of silver a year.

Rio Sierra Silver started up the Nevada Park mine in Lincoln County in 1984. It has been developing, mining and stockpiling ore. This ore varies from over 10 ounces to 180 ounces of silver per ton.

FMC Corporation of Chicago, a firm diversified in mining, industrial machinery and chemicals, has discovered an extremely rich deposit near Gabbs and Paradise Peak, Nevada. Reserves may comprise up to 1,000 metric tons of silver and 30 tons of gold. Silver averaged 4.7 ounces per ton. The ore is reportedly near the surface and easy to mine and therefore production may commence by end-1985.

The Hamilton project of United Hearne Resources could produce 8 metric tons of silver a year from late 1984 from heap leaching of century old dumps and tailings. U.S.$500,000 spent. The Battle Mountain gold mine produces silver. Production from the Copper Canyon mine has averaged about 28 metric tons of silver a year.

The nearby Fortitude gold and silver project of Duval has started to ship ore, following the speeded up pre-mining stripping stage. It contains about 290 metric tons of silver and 75 tons of gold. It should come on stream late in December, 1984. It should produce over 7.7 metric tons of silver a year and over 6 tons of gold.

The rehabilitated Gooseberry mine of Asamera Inc. and Ican Resources Ltd., Vancouver, Canada, near Reno, Nevada came on stream in August, 1983, with annual output of 9.5 metric tons of silver and 0.2 ton of gold per annum and has reached output capacity.

Cominco of Canada's U.S.$12 million Buckhorn mine, will have start-up in the spring of 1985 and should produce 7.7 to 8.5 metric tons of silver a year.

The Wonder mine dumps of Belmont Resources, located in Churchill County, Nevada may be treated by leaching, to recover some of the estimated 4.3 metric tons of silver contained and in portions of veins near the surface containing about 2.66 tons of silver.

A U.S.$10 million exploration program indicates of around 1,100 metric tons of silver at the Silver King Mines Ward properties south of Ely, Nevada. Phase one of mine development is nearly complete.

New Mexico

Tyrone mine, Phelps Dodge, was the main silver producer in 1981. 14,000 tons additional mineral output will be available from 1984.

The Continental mine produces silver. Copper Flat Partners, Sierra Co. (Quintana, operator).

The St. Cloud silver mine of Goldfield Corporation has a new mining area in 1984 with less silver and higher gold grades; silver at 8.6 ounces per metric ton.

California

Pre-production work has begun at Sonora Gold Corporation's U.S.$40 million Jamestown mine in Tuolumne County, with an output target of 4.4 metric tons of silver and 3.7 tons of gold a year. Sonora Gold is part of ABM Mining Group Inc., a Canadian company in Vancouver, British Columbia.

The Blue Moon prospect of Colony Pacific Explorations and Westmin Resources grades 2.31 ounces per metric ton.

The Lava Cap gold prospect of Franco-Nevada Mining grades 3.43 ounces of silver per metric ton.

The Quail Hill and Gopher Hill prospects of Getty Mining, 100 kilometres east of Stockton, has graded 178 g. silver per ton.

Washington State

Hecla's Knob Hill gold-silver mine near Republic, Washington has a grade of 1.43 ounce silver per metric ton, but it will probably not close in 1984 after all, because it has located additional reserves of up to 3 tons of silver and half a ton of gold. Yield will probably be between 2 and 2.25 metric tons of silver a year.

Alaska

Cominco of Canada has awarded contracts to three companies to begin work in 1984 on development of the U.S.$400 million dollar Red Dog zinc-lead deposit in northwest Alaska which indicates 75 g. or 2.4 Troy ounces silver per metric ton, 17.1 per cent zinc and 5.6 per cent lead. It could produce about 32 metric tons of silver a year. It may be the world's largest undeveloped lead-zinc deposit. Open pit mining is feasible. The mine's production costs may place it advantageously in the bottom one third of world zinc mines — a tremendous edge. A production decision is expected late in 1984 or in 1985. It should become Cominco's largest and richest zinc-lead mine.

The State of Alaska shows strong support for the development of Red Dog.

In 1848, the Russian engineer, R.P. Doroshin, discovered gold in the Kenai river in Russian Alaska.

SOME SILVER PRODUCING MINES

U.S.A.	Mine or Location	Metals Produced
Alaska		
Little Squaw Mining	Chandalar operations	Silver, Gold
Nerco Metals	Candelaria partners	Silver, Gold
Arizona		
Magna Copper	San Manuel Division	Silver, Gold, Copper, etc.
Asarco	Mission Unit	Silver, Copper, etc.
Veta Grande	Mohawk mine	Silver
Duval Corporation	Sierrita	Silver, Copper, etc.
Inspiration Consolidated	Inspiration Division	Silver, Gold, Copper
California		
Cash Industries	Milford operations	Silver, Gold, Palladium, etc.
Iron Mountain	Iron Mountain operations	Silver, Gold, Platinum, etc.
Siskon Corporation	Gray Eagle Mine	Silver, Gold, Copper
Colorado		
Asarco	Leadville Unit	Silver, Lead, Zinc
Day Mines	Leadville Unit	Silver, Lead
Hendricks Mining	Nederland Operations	Silver, Gold, Lead, etc.
Standard Metals	Silverton operations	Silver, Gold, Lead, etc.
Texasgulf	Cripple Creek and Victor	Silver, Gold
Idaho		
Asarco	Northwest Mining Department, Coeur and Galena Units	Silver, Copper
Clayton Silver Mines	Clayton Mine	Silver, Lead
Hecla Mining	Leadville Unit,	Silver, Lead, Gold
Mapco Minerals	Lucky Friday and Republic DeLamar Mine	Silver, Gold
Salmon Canyon Copper	Shoup operations	Silver, Gold, Cobalt, Copper, etc.
Sunshine Mining	Sunshine Mine	Silver, Copper, Lead, etc.

SOME SILVER PRODUCING MINES (Continued)

U.S.A.	Mine or Location	Metals Produced
Michigan		
Callahan Mining	Ropes Gold Mine	Silver, Gold
Copper Range	White Pine Copper Division	Silver, Copper
Missouri		
Amax Lead/Homestake Lead	Buick Mine	Silver, Lead, Zinc, etc.
Cominco American	Magmont Mine	Silver, Lead, Zinc, etc.
Montana		
Anaconda Minerals	Butte	Silver, Gold, Copper
Asarco	Troy Unit	Silver, Copper
Black Pine Mining	Black Pine Mine	Silver, Gold
Golden Jubilee Corporation	Golden Jubliee	Silver, Gold
Hughes Mining	Gold Ranch and Kennett	Silver, Gold
Queen Florence	Neihart operations	Silver, Lead, Zinc
U.S. Antimony	Yankee Fork Silver & Gold	Silver, Gold
Nevada		
Asamera	Gooseberry	Silver, Gold
Cominco American	Buckhorn Mine	Silver, Gold
Cortez Gold	Cortez	Silver, Gold
Cyrus Northumberland	Mine	Silver, Gold
Duval Corporation	Battle Mountain	Silver, Gold, Copper
Freeport Gold	Elko operations	Silver, Gold
Intermountain Exploration	Comstock Gold	Silver, Gold
Kay Mining & Milling	Sandy Valley	Silver, Platinum, Iridium, Palladium, Gold
Occidental Minerals (Oxymin) (Occidental Petroleum)	Candelaria operations	Silver, Gold
Standard Slag	Atlanta Mine	Silver, Gold
Sunshine Mine	16-1 (Sixteen to One) Mine	Silver, Gold

SOME SILVER PRODUCING MINES (Continued)

U.S.A.	Mine or Location	Metals Produced
Nevada (Continued)		
United Mining	Independence, New Savage and Virginia City	Silver, Gold
New Mexico		
Phelps Dodge	Tyrone Branch	Silver, Gold, Copper
St. Cloud Mining	St. Cloud Mine	Silver, Gold, Copper
San Pedro Mining	San Pedro Mine	Silver, Gold, Copper
Oregon		
Brooks Minerals	Cracker Creek	Silver, Gold
Shiny Rock Mining	Ruth Mine	Silver Gold, Zinc, etc.
Utah		
Kennecott	Utah Copper Division	Silver, Gold, Copper, etc.

U.S. NET IMPORT RELIANCE ON SELECTED MINERALS — 1983

	Per Cent of U.S. Usage Imported into U.S.	Major non-U.S. Sources
SILVER	61	CANADA, Mexico, Peru, U.K. refiners and bullion dealers
Gold	21	CANADA, Switzerland, Soviet Union
Platinum Group Metals	84	South Africa, Soviet Union, CANADA
Chromium	77	South Africa, Soviet Union, Philipines
Nitrogen	11	CANADA, Soviet Union, Trinidad, Mexico
Zinc	66	CANADA, Peru, Mexico, Australia

5.3.5. CANADA AND ONTARIO

Jacques Cartier the Breton first referred to silver in Canada after his second voyage of 1534-36, sixteen years after Cabot's discovery of Newfoundland, and this was probably native silver from what is now Cobalt, Ontario. Champlain mentioned silver in 1613 at St. Mary's Bay, Nova Scotia. Some Indians had silver artifacts.

Canada is now the third largest mineral economy in the world and the largest mineral exporter.

Ontario's mineral output over ten years ago in 1973 was valued at almost $2 billion, but Ontario minerals reached $4.5 billion in value in 1980.

CANADA — MINE OUTPUT OF SILVER

(thousand metric tons)

1980	**1981**	**1982**	**1983 est.**	**1984 est.**
1.07	1.129	1.204	1.106	1.29

Canada's position in the years in which it was the world's top producer of newly mined silver and later the second largest may be seen in the following table.

SILVER PRODUCTION — WESTERN WORLD

(in Metric Tons)

	Canada	**Mexico**	**U.S.A.**	**Peru**
1967	1,129	1,191	998	998
1968	1,400	1,244	1,017	1,132
1969	1,353	1,334	1,303	1,117
1970	1,378	1,331	1,350	1,238
1971	1,428	1,141	1,294	1,194
1972	1,393	1,166	1,157	1,250
1973	1,477	1,207	1,166	1,306
1974	1,331	1,166	1,051	1,275
1975	1,216	1,306	1,061	1,182
1976	1,281	1,325	1,067	1,107
1977	1,331	1,462	1,188	1,123
1978	1,250	1,580	1,225	725

Canada was the free world's leading mine producer of silver for the period from 1968 through 1974 and second largest producer 1975 through 1978 and in 1967.

This Canadian prominence in silver was a reflection of the high silver output of the Kidd Creek mine in Ontario in its early years.

SILVER — ESTIMATED MINE OUTPUT OF SILVER OF CANADIAN COMPANIES, 1983

	Metric tons of Silver a year
Cominco	356.2
Kidd Creek, Ontario	190.6
Brunswick Mining (Noranda 64 per cent)	188.6
Equity Silver	154.2
Noranda, Ontario, etc.	146.9
Placer Development, (including outside Canada) (Noranda 32 per cent)	84.3
Lacana Mining (includes production outside Canada)	61.6
Terra Mines	46.6
Agnico Eagle, Ontario	24.9
Westmin	24.3
Teck	24.5
United Keno	19.8
Inco, Ontario	19.3
Avino Mines (including outside Canada)	12.4
Sherritt Gordon	11.7
Falconbridge Copper	11.7
Asamera (Gooseberry, U.S.A., 90 per cent)	8.6
Pegasus Gold (including outside Canada)	5.8
Northgate (including outside Canada)	4.9
Others	
Total Yearly Silver Production	1,454.0

n.b. These are companies, not mines per se; preliminary estimate of 1983 silver output from Canadian mines is 1,106.0 metric tons.

Canada almost looks like a developing country, as far as mineral investment is concerned. It provides:

1) A superb geological endowment over an enormous area, second only to the Soviet Union.
2) Exploration that is easy and cheap.
3) Excellent professional people in the mineral exploration and mining industry.

Canada is also almost completely self-sufficient in mineral needs.

Central policies in recent years have made Canada less attractive to international finance as an investment destination, but the new Mulroney administration is starting to improve the situation.

Minerals represent some 18 per cent of Canada's total exports by value.

However, exploitable mineral deposits are generally of low grades, long transport distances are involved in remote areas, industry wages are high and taxation and environmental requirements are high, compared to some jurisdictions.

ONTARIO MINE OUTPUT OF SILVER
(metric tons)

Companies Producing in 1983	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983p
Kidd Creek Mines Ltd., formerly Texasgulf Canada Ltd., formerly Ecstall Mining Ltd.	255.7	255.7	254.7	221.6	201.7	179.7	217.6	147.0	182.5	206.4
Noranda Mines Ltd. and Mattabi Mines Ltd. (includes "F" Group, Lyon Lake and Geco Div.)	166.8	110.1	122.6	126.4	98.7	117.7	108.4	86.0	89.8	113.8
Inco Ltd., formerly the International Nickel Co. of Canada Ltd.	54.6	46.8	46.9	51.9	30.8	23.9	46.7	46.96	32.66	19.28
Agnico-Eagle Mines Ltd.	13.7	8.4	5.6	5.8	7.6	5.1	11.3	11.3	15.5	24.3
Teck Corp. (Silverfields Div.)	25.3	14.7	16.5	26.4	23.6	13.9	16.6	19.4	18.7	7.7
Falconbridge Ltd., formerly Falconbridge Nickel Mines Ltd.	6.8	4.9	5.2	5.4	3.9	5.0	5.9	5.5	3.2	5.4
Pamour Porcupine Mines Ltd. (Noranda)	1.8	2.2	2.2	2.1	2.7	1.8	1.6	1.6	1.8	1.8
Campbell Red Lake Mines Ltd.	.5	.5	.5	.5	.5	.6	.5	.6	.6	.7
Dome Mines Ltd.	.6	.6	.6	.6	.7	.5	.4	.4	.5	.6
Lac Minerals Ltd. (Macassa Div., formerly Willroy Mines, Macassa Div. and Lake Shore Div., formerly Lake Shore Mines Ltd.)	.3	.3	.3	.3	.3	.3	.3	.2	.2	.3
Renabi Mines (1981) Ltd.	.2	.1	.1	.2	.2	.1	.1	.1	.2	.2

ONTARIO MINE OUTPUT OF SILVER (Continued)
(metric tons)

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983p
Dickenson-Sullivan J.V., formerly Dickenson Mines Ltd. (includes Robin Red Lake Mines Ltd.)	.2	.1	.1	.2	.2	.1	.1	.1	.2	.2
Kerr Addison Mines Ltd. (Noranda 49 per cent)	.2	.2	.2	.2	.1	.1	.1	.1	.1	.1
Others including Consolidated Louanna Gold Mines Ltd., Detour Lake J.V., Goldlund Mines Ltd., and Sulpetro (Canadaka)	.8	.6	.6	8.5	9.8	3.9	4.9	5.8	-	2.6
Former Producers										
Selco Inc., formerly Selco Mining Corp. Ltd. (South Bay Div.)	13.7	9.5	7.5	7.4	5.2	5.3	4.1	1.5		
Falconbridge Copper Ltd. (Sturgeon Lake J.V.)	4.1	27.5	32.7	60.3	53.1	48.2	37.2			
Umex Inc., formerly Union Miniere Exploration and Mining Corp. Ltd.			.7	3.8	5.2	5.4	5.3	3.0	1.2	
Willroy Mines Ltd. (excluding Macassa Div.)	8.8	11.0	10.1	3.0						
Others including Pancontinental Mining (Canada) Ltd., Wilanour Resources Ltd., Hollinger Mines Ltd., Bulora Corp. Ltd., Prace Mining Ltd. (Tribag Property) and Sheridan Geophysics. (Maybrun Property).	1.3	.6	.1					1.3		

p = preliminary

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ONTARIO MINE OUTPUT — VALUE OF PRINCIPAL METALS PRODUCED

($ millions)

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Silver	29	33	50	83	67	70	83	88	172	335	137	119	198	177
Gold	40	58	89	124	123	91	115	154	221	404	334	307	389	400
Precious Metals, total	109	125	170	268	247	211	261	308	450	898	607	508	666	697
Nickel	584	519	565	749	816	882	927	474	566	1155	1,001	441	550	926
Copper	317	293	353	484	372	391	428	324	457	631	521	298	457	552
Iron Ore	136	219	145	180	214	252	287	308	287	262	245	193	184	235
Zinc	122	150	214	335	278	263	231	213	279	243	286	258	281	414

Canada produced little silver until late in the 19th Century.

Mine production of silver in Canada greatly accelerated after World War II and has often exceeded U.S. or Mexican output since 1950.

In many recent years, with Canada the world's leading mine producer of silver, the Province of Ontario has been a major contributor, largely due to the sizeable silver production from the Kidd Creek mine at Timmins from 1966 onwards.

Canada became the free world's largest mine producer of silver in 1968 and remained in that position through 1974. Mexico and Peru have been the leaders most of the time since.

Canada ranked fourth in the world in silver output in 1983 with 1,340 metric tons, up a little from 1982. It is possible that Canada could still occupy fourth position in the years 1984 through 1986.

However, Canada's silver output may stay at the 1,200 metric tons per annum level for the next 5 years.

Canada's recent exports of silver have been as follows:

	1982	**1983 est.**
Metric tons	1,737	1,487
Value	C.$507 million	$630 million

The value of Canadian mine output of silver was helped by the higher average price in 1983 compared to 1982.

Some silver is refined to metal from ores and from scrap at a number of secondary processing facilities in Ontario.

SILVER OUTPUT FROM CANADIAN MINES

The bulk (about 76 to 80 per cent) of new Canadian silver is a by-product of base metal mining and therefore its annual production volume largely depends on the output decisions taken for the mining of copper, zinc, lead and nickel.

Ontario — Early Silver Mines

Ontario alone typically produces about 8 per cent of the world's newly mined silver. Until quite recent years, Ontario had the world's single largest silver producing mine, discovered only twenty years ago at Kidd Creek.

Few areas on earth are as rich in metals in the ground as Ontario.

As far back as 1846, large veins of native copper/copper sulphide containing silver were discovered at Prince's mine, near Port Arthur on Lake Superior in northwestern Ontario.

Silver was thus found in Ontario about 20 years before gold was.

In 1866, at Thunder Bay, Peter McKellar discovered a vein with a predominant content of silver, partly in the native form (naturally occurring metallic silver) and partly as argentite and this was worked until 1874.

In 1867, the Shuniah or Duncan mine in Port Arthur, Thunder Bay was discovered, having some rich ore, assaying 2,020 ounces silver per ton.

In 1868, the fabulously rich Silver Islet mine was discovered in Ontario, on a small islet no larger than a good sized ballroom, in stormy Lake Superior. In its 16-year life, it produced about $3.5 million — in the dollars of those days.

In 1870, the Breck or Silver Harbour mine contained a vein about 5 feet thick, mostly of white quartz and produced a quantity of silver.

In 1884, rich silver ore was found, later called Silver Mountain in McIntyre township, Thunder Bay and two silver mines opened.

In 1888, the Rabbit Mountain group of silver mines were discovered, with native silver and argentite.

In northeastern Ontario, the Ontario Government built a rail line northeast to the fertile land north of Lake Timiskaming and while the track was being laid in 1903, McKinley and Darragh discovered native silver of an incredible grade of *4,000 ounces of silver to the ton.*

One mile north, Larose and McMartin discovered more silver.

A few weeks later, Tom Hebert discovered a silver vein and this became the Nipissing Mining property. A few days later, he also discovered the "Little Silver", from which $500,000 of silver was taken — in the dollars of those days.

The last silver discovery associated with the railway construction during 1903 was made at what became the O'Brien mine.

The Cobalt area silver mining camp was thus born because of a new Ontario government rail line and Cobalt went on to prosper greatly. Cobalt produced over 400 million ounces of silver or about 12,440 metric tons of silver.

The Crown-Reserve Mining Company, a predecessor of Agnico-Eagle, Cobalt, reported high grade ore that ran *close to 5,000 ounces of silver per ton* in 1909 and produced 624 metric tons of silver from 1908 to the early 1930's

See Appendix I for further details on Early Ontario Silver Mines and the Haileybury School of Mines.

Ontario — Silver Output

Ontario was the leading silver producing Province in Canada up to 1980 but fell behind British Columbia in 1981, 1982 and 1983. Ontario leads the country in mine output of nickel, platinum group metals, zinc, cadmium, uranium, cobalt and usually gold.

Ontario's recent mine production of silver peaked as recently as 1969 at 692 metric tons, (apart from the short 1909 to 1915 period, which was higher). 1984 output is estimated as 506 metric tons. It was Ontario's highest silver output since 1977.

Ontario's mine output of silver in 1980 had a record value of $335 million.

The Kidd Creek mine, (formerly Texasgulf Canada, formerly Ecstall Ltd.), (now owned by the federal government's Canada Development Corporation), which is likely to be sold by the new Mulroney administration, located at Timmins in northeast Ontario, Canada, the world's single largest silver producer in the late 1960's and 1970's and now the leading producer in Ontario, expects its silver production to decline significantly as it goes deeper and deeper for ore. It graded 0.43 troy ounce of silver per ton in the early days. At Kidd Creek, ore near the surface was rich in silver but the grade of silver has declined with depth. Kidd Creek produced about 161.7 tons of silver in the first three quarters of 1984. It commenced production in 1966 and operated at normal rates in 1983. In the first 6 years, Texasgulf produced some 1,710 metric tons of silver but mostly in the first 3 years because, in those days, Canadian federal taxation rules allowed a very fast write-off under the 3-year rule and the grade diminished with depth.

Presently, over 50 per cent of Ontario's newly mined silver comes from the Timmins area.

Kidd Creek mines will expand the capacity of its copper smelter and refinery from 59,000 to 90,000 metric tons by 1988. With other improvements, total cost will be about $54 million. The zinc refinery will also be expanded by 1986 at a cost of another $6 million.

Some Ontario gold mines have produced byproduct silver, e.g. Dome Mines, Kerr Addison. The Royal Canadian Mint in Ottawa, Ontario also recovers silver from crude gold bullion from mines, as do some secondary refineries in Ontario. Dome celebrated its 75th anniversary in 1984 by officially opening a $96 million expansion program, which took 4 years to complete.

Noranda's silver-producing zinc-copper mines in the Sturgeon Lake area of Ontario operated at normal levels in 1983. With 0.60 ounces silver per ton Noranda's Geco mine at Manitouwadge is one of the largest producers of silver in Canada.

At Hemlo, Ontario, the large discoveries of 1981 are being developed as three gold mines, with a useful silver content.

The new Hemlo gold deposits grade between 1 and 2 g. of silver per ton.

The ore is in a wide band, unlike the typically narrow Canadian quartz veins.

By early May, 1984, drilling indicated a total of 560 metric tons of gold worth about U.S.$7 billion, contained in ore reserves.

The new Hemlo mines may, in terms of mining costs, be among the lowest 10 per cent of the world's gold producers.

Noranda, at the Goliath Gold Mines and Golden Sceptre Resources properties at Hemlo, Ontario, is spending $200 million to $250 million by 1987 to develop a new mine. Output costs could be as low as U.S.$130 an ounce. Startup in the spring of 1985, at up to 6 metric tons of gold a year could eventually build to 9.4 metric tons of gold a year.

Compare the largest 1983 U.S. producer, Homestake, with 9.6 metric tons a year.

Teck Corporation, with International Corona, at the Corona property at Hemlo, Ontario, is spending $90 million to develop a new mine. Milling is scheduled to start in July 1985 at 75 per cent capacity. Output in the early years should be 4.7 metric tons of gold a year, at a cost per ounce lower than 90 per cent of the world's gold mines.

Lac Minerals Ltd. is developing a new mine at the Williams property at Hemlo, open pit at first, at a cost of some $250 million during the next six years. Output, commencing in July, 1986, could be 5.2 metric tons of gold a year which will eventually double as development is completed, to about 10.4 metric tons of gold a year.

In the Cobalt area, advanced exploration for silver has produced underground development at the Cameron property of Silver Lake/Lacana/Teck, shaft underground development at the Zenith mine of Falco Copper/Zenmac and ramp underground development in the Lorrain Township property of Silversides.

A predominant portion of new silver output is a byproduct of base metal mining in Canada. The Sudbury, Ontario, nickel mines, like the Soviet ores, are not solely dependent on nickel revenues and, therefore, have the advantage, as compared to most other nickel operations in the world, i.e. laterites, of deriving revenue from the byproducts, silver, gold, platinum group metals, copper, cobalt, selenium, tellurium, sulphuric acid and up to 1982, iron ore.

ONTARIO SILVER PRODUCTION BY MINE CLASSIFICATION

(metric tons)

Year	From Silver and silver-cobalt mines	From Gold mines	From other (base metal) mines	Total	Nominal Value (millions of Canadian Dollars)
1901	4.51			4.51	0.08
1902	3.01			3.01	0.06
1903	0.50			0.50	0.01
1904	5.46		0.97	6.43	.011
1905	76.25		0.69	76.94	1.37
1906	168.17		0.85	169.02	3.69
1907	310.94	0.01		310.94	6.15
1908	604.78	0.01		604.79	9.14
1909	808.89			808.89	12.65
1910	961.13	0.01		961.14	15.62
1911	979.74			979.74	16.18
1912	940.72	0.53	14.28	955.53	17.70
1913	925.44	1.35		926.79	16.59
1914	781.25	1.72		782.97	12.83
1915	755.12	2.40		757.52	11.95
1916	617.93	2.86	0.01	620.80	12.67
1917	603.47	2.36	0.04	605.87	16.18
1918	539.24	2.29	0.09	541.62	17.41
1919	347.98	2.88	1.75	352.56	12.90
1920	337.36	3.09	3.73	344.18	10.86
1921	256.69	3.86	1.56	262.11	5.67
1922	322.77	5.07	1.56	339.40	7.79
1923	322.71	4.96	3.14	330.81	6.84
1924	309.49	6.68	3.82	319.99	6.94
1925	362.32	7.83	4.18	374.33	8.30
1926	310.65	7.76	4.73	323.14	6.34
1927	267.10	8.46	5.85	281.41	5.17
1928	209.49	7.72	7.30	224.51	4.19
1929	241.91	8.02	15.03	264.96	4.38
1930	284.44	9.32	34.89	328.65	4.03
1931	186.57	11.33	25.60	223.50	2.21
1932	144.90	13.87	20.65	179.42	1.76
1933	113.28	12.71	31.92	157.91	1.89
1934	94.23	13.46	56.68	164.37	2.49
1935	111.02	14.05	69.79	194.86	4.01
1936	67.14	15.22	77.28	159.64	2.29
1937	50.68	15.99	73.53	140.20	2.01
1938	42.28	16.71	77.92	136.96	1.91
1939	44.80	21.67	77.65	144.12	1.86
1940	24.99	45.95	87.18	158.12	1.85
1941	10.89	54.84	82.22	147.95	1.79
1942	22.20	41.26	70.65	134.11	1.75
1943	19.42	26.74	51.90	98.06	1.36

ONTARIO SILVER PRODUCTION BY MINE CLASSIFICATION (Continued)

(metric tons)

Year	From Silver and silver-cobalt mines	From Gold mines	From other (base metal) mines	Total	Nominal Value (millions of Canadian Dollars)
1944	15.33	19.28	57.08	91.69	1.24
1945	4.73	30.29	53.97	88.99	1.32
1946	9.99	26.47	44.67	81.13	2.17
1947	13.91	18.25	42.92	75.08	1.72
1948	16.97	25.71	43.68	86.36	2.16
1949	41.49	12.58	37.42	91.49	2.21
1950	107.68	13.01	32.51	153.20	4.08
1951	141.71	13.38	38.09	190.22	5.78
1952	135.97	12.72	38.48	187.17	5.01
1953	109.99	11.10	39.24	160.33	4.33
1954	122.30	5.94	41.08	169.32	4.53
1955	126.48	12.68	49.05	188.21	5.84
1956	146.86	12.72	46.53	206.11	5.94
1957	134.26	13.24	67.43	214.93	6.03
1958	187.97	13.76	103.57	305.29	8.53
1959	207.06	12.70	108.10	327.86	9.25
1960	222.57	13.78	112.66	349.01	9.98
1961	145.59	12.58	117.73	275.90	8.36
1962	146.42	12.36	133.08	291.86	10.93
1963	157.18	10.73	130.73	298.64	13.29
1964	165.18	11.37	132.30	308.85	13.90
1965	180.41	11.51	144.69	336.61	15.15
1966	173.54	9.74	155.75	339.03	15.25
1967	119.44	10.39	315.24	445.07	24.78
1968	135.07	10.24	534.13	579.44	50.53
1969	130.25	8.45	553.68	692.38	42.96
1970	87.35	8.30	522.58	618.23	36.77
1971	80.59	7.22	493.25	581.06	29.14
1972	79.14	5.53	524.58	609.25	32.71
1973	69.96	5.23	534.94	610.17	49.55
1974	39.83	4.10	511.34	555.27	82.64
1975	23.74	4.29	435.66	463.69	67.18
1976	28.03	4.03	480.46	507.52	70.13
1977	40.14	3.79	479.79	524.32	82.94
1978	41.01	4.65	398.70	444.36	88.16
1979	22.87	3.76	385.32	411.95	171.83
1980	32.87	3.02	425.14	461.03	335.57
1981	36.59	2.96	389.23	328.78	136.97
1982	35.47	3.99	307.51	346.97	118.68
1983	n.a.	n.a.	n.a.	415.00	n.a.
1984 (preliminary estimate)	n.a.	n.a.	n.a.	506.00	n.a.

PRODUCTION FROM ONTARIO'S PRINCIPAL SILVER CAMPS

A. The Cobalt Camp	Metric Tons Silver	Nominal Value (millions of Canadian dollars)
1904	5.46	0.10
1905	76.25	1.36
1906	168.01	3.67
1907	310.94	6.15
1908	604.35	9.13
1909	801.82	12.53
1910	936.20	15.23
1911	932.53	15.18
1912	889.78	16.47
1913	876.41	15.66
1914	749.93	12.30
1915	740.62	11.69
1916	589.73	12.04
1917	570.04	15.22
1918	512.67	16.51
1919	319.90	11.72
1920	323.54	10.22
1921	238.39	5.15
1922	286.99	6.65
1923	225.73	4.66
1924	208.99	4.53
1925	233.75	4.95
1926	177.49	3.48
1927	140.79	2.60
1928	122.36	2.28
1929	149.91	2.51
1930	162.98	1.95
1931	115.29	1.17
1932	101.45	1.01
1933	74.56	0.86
1934	61.90	0.91
1935	83.33	1.71
1936	46.81	0.66
1937	32.97	0.47
1938	25.34	0.35
1939	28.65	0.35
1940	24.44	0.26
1941	10.75	0.11
1942	15.93	0.17
1943	14.01	0.17
1944	7.53	0.09
1945	3.35	0.05
1946	8.93	0.23
1947	10.01	0.22
1948	11.27	0.31

PRODUCTION FROM ONTARIO'S PRINCIPAL SILVER CAMPS (Continued)

A. The Cobalt Camp	Metric Tons Silver	Nominal Value (millions of Canadian dollars)
1949	22.01	0.52
1950	81.68	2.19
1951	99.40	3.02
1952	77.82	2.09
1953	42.97	1.11
1954	67.05	1.71
1955	74.69	2.18
1956	74.40	2.15
1957	76.39	2.15
1958	101.90	2.85
1959	83.64	2.36
1960	101.17	2.89
1961	49.92	1.51
1962	56.81	2.13
1963	95.52	4.25
1964	94.41	4.25
1965	127.33	5.73
1966	123.59	5.56
1967	82.90	4.62
1968	96.74	7.19
1969	100.62	6.24
1970	74.92	4.46
1971	54.29	2.72
1972	50.38	2.70
1973	69.95	5.68
1974	39.83	5.93
1975	2.59	.42
1976	22.68	.13
1977	40.69	6.44
1978	41.01	8.14
1979	22.87	9.54
1980	32.87	26.32
1981	36.59	12.35
1982	35.47	13.94
Total	14,298.19	404.51

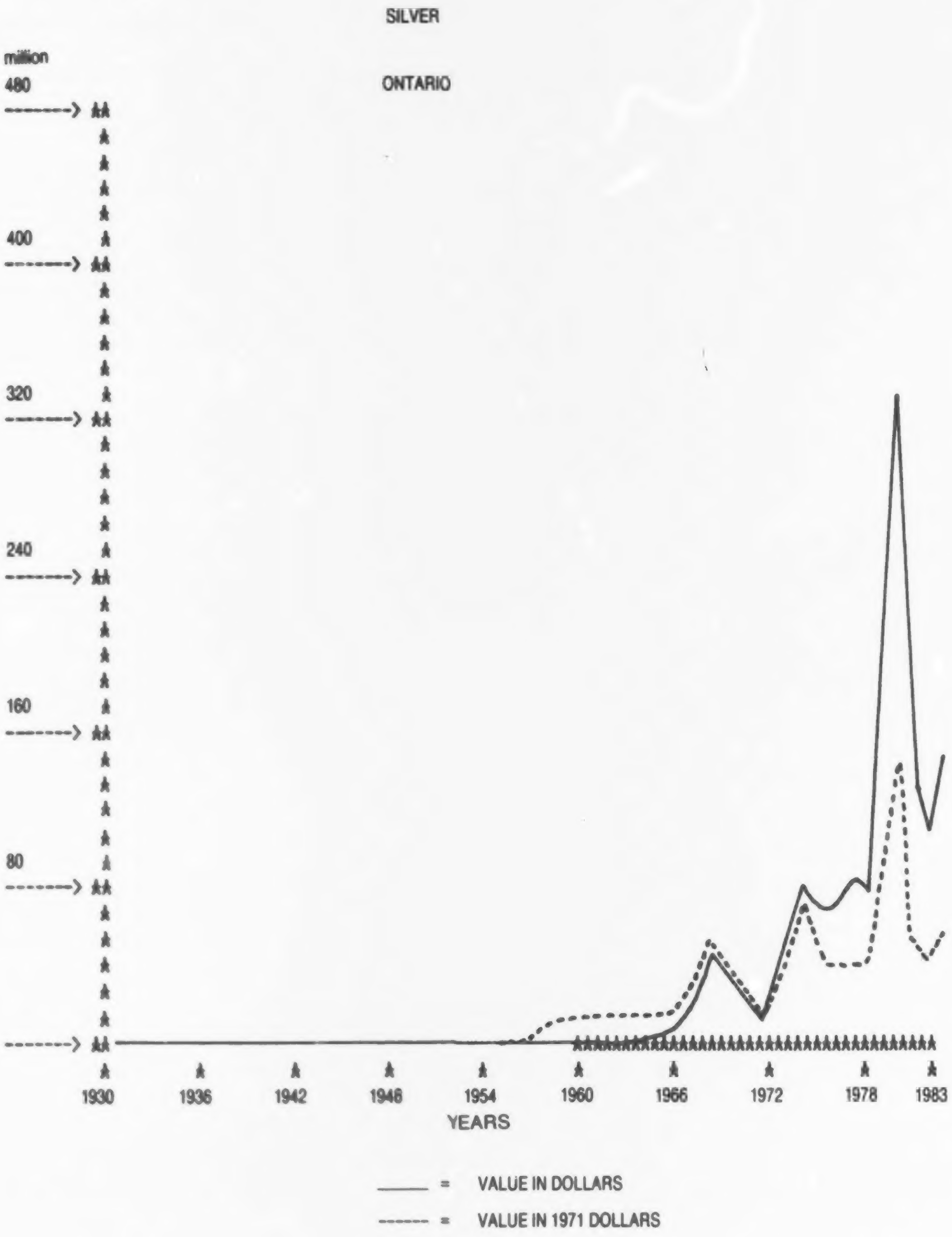
B.

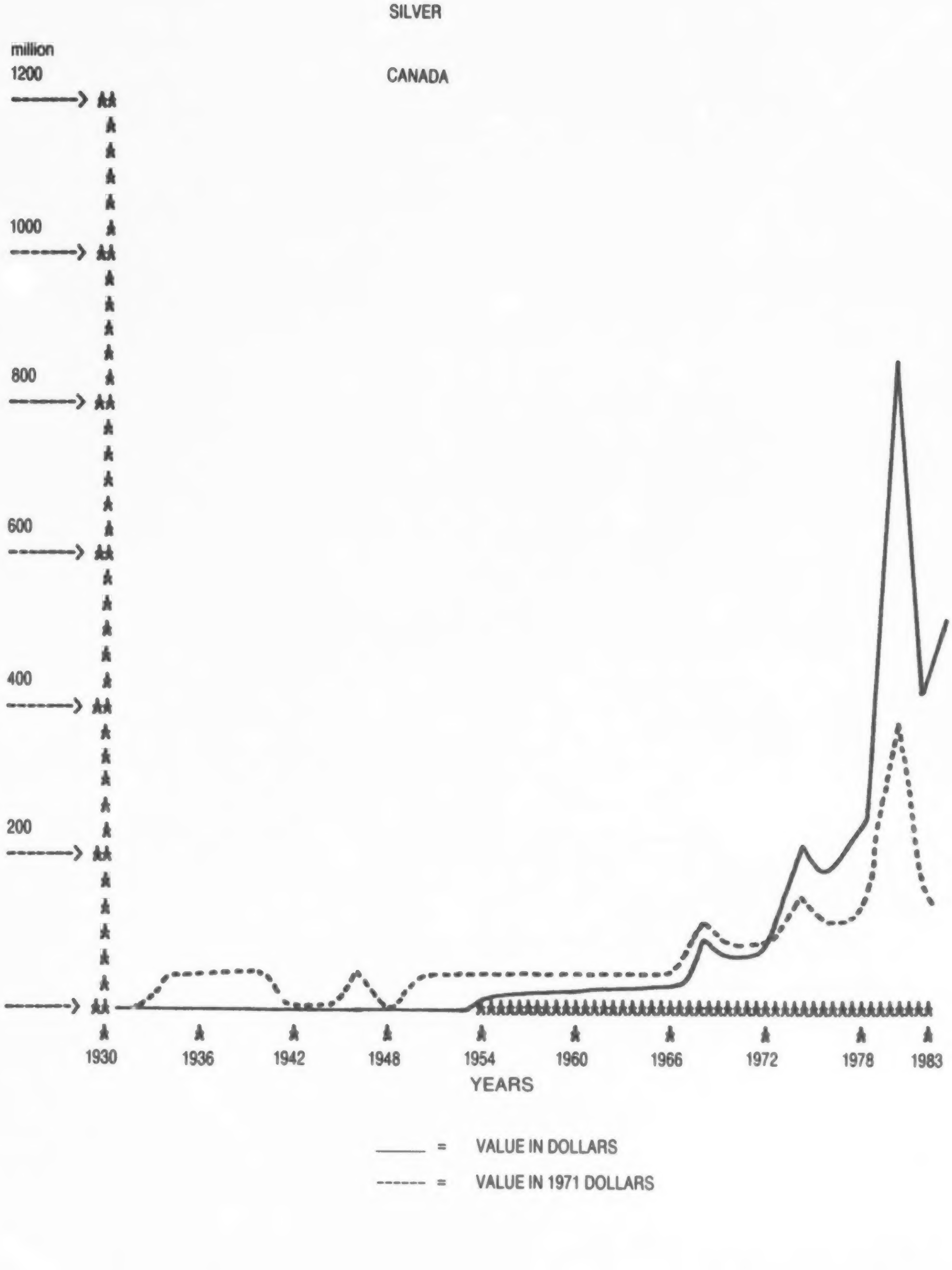
Gowganda	**Metric Tons Silver**	**Nominal Value (millions of Canadian dollars)**
1910	14.99	0.24
1911	14.59	0.24
1912	17.11	0.32
1913	15.63	0.29
1914	12.42	0.21
1915	7.53	0.12
1916	11.92	0.25
1917	33.11	0.89
1918	19.85	0.62
1919	22.51	0.83
1920	13.52	0.42
1921	8.03	0.18
1922	5.31	0.11
1923	5.00	0.10
1924	18.60	0.40
1925	42.15	0.93
1926	38.46	0.74
1927	54.17	0.98
1928	52.17	0.97
1929	64.75	1.04
1930	66.56	0.76
1931	52.79	0.53
1932	42.76	0.42
1933	38.72	0.50
1934	32.33	0.51
1935	25.79	0.53
1936	10.91	0.29
1937	16.24	0.23
1938	15.64	0.22
1939	15.49	0.21
1940	0.17	0.00
1941	—	—
1942	5.96	0.07
1943	5.37	0.07
1944	7.80	0.10
1945	1.39	0.02
1946	—	—
1947	2.93	0.06
1948	5.70	0.17
1949	19.48	0.49
1950	26.00	0.71
1951	42.29	1.29
1952	58.15	1.56
1953	60.49	1.62
1954	69.51	1.70
1955	57.54	1.60
1956	50.02	1.35

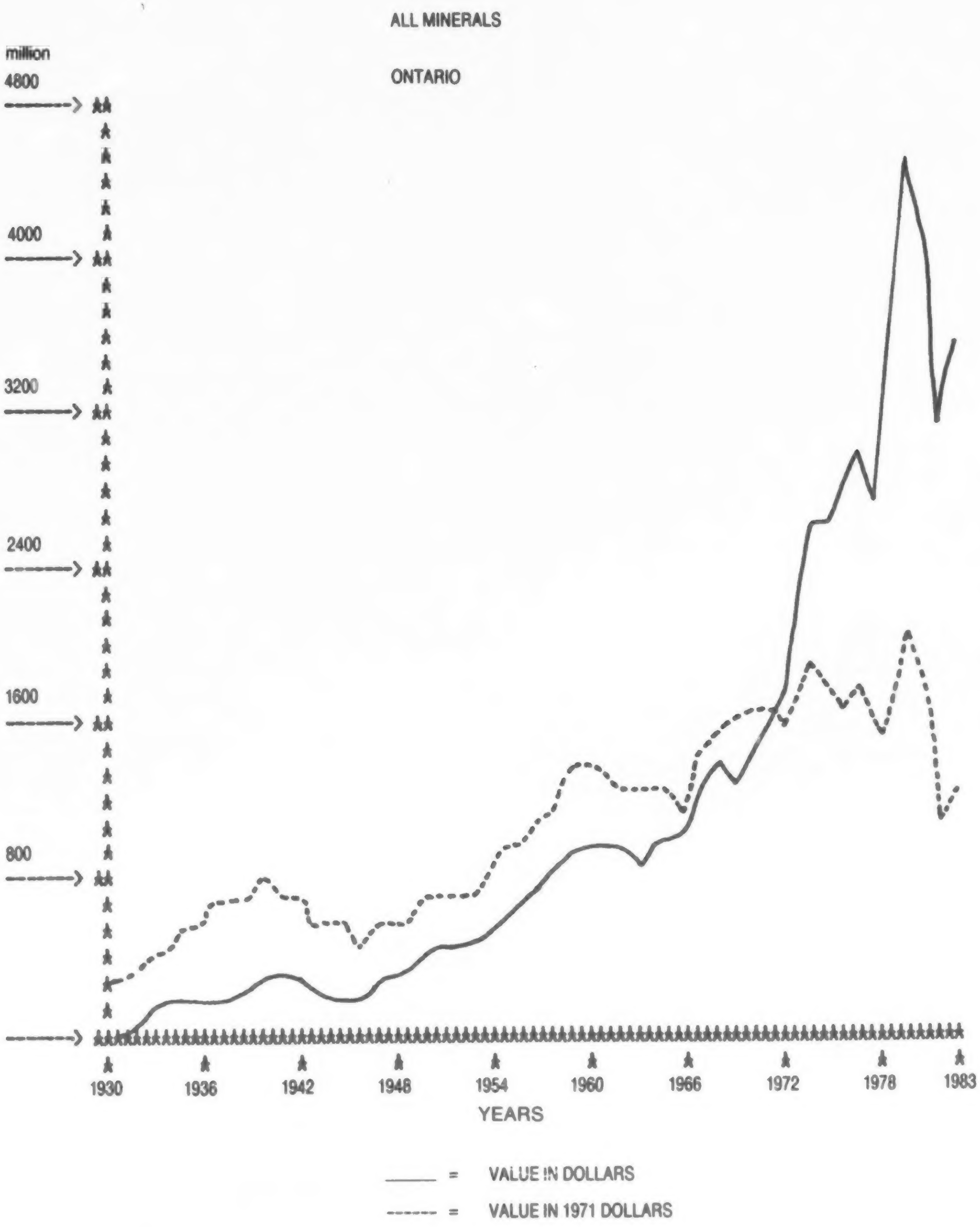
PRODUCTION FROM ONTARIO'S PRINCIPAL SILVER CAMPS (Continued)

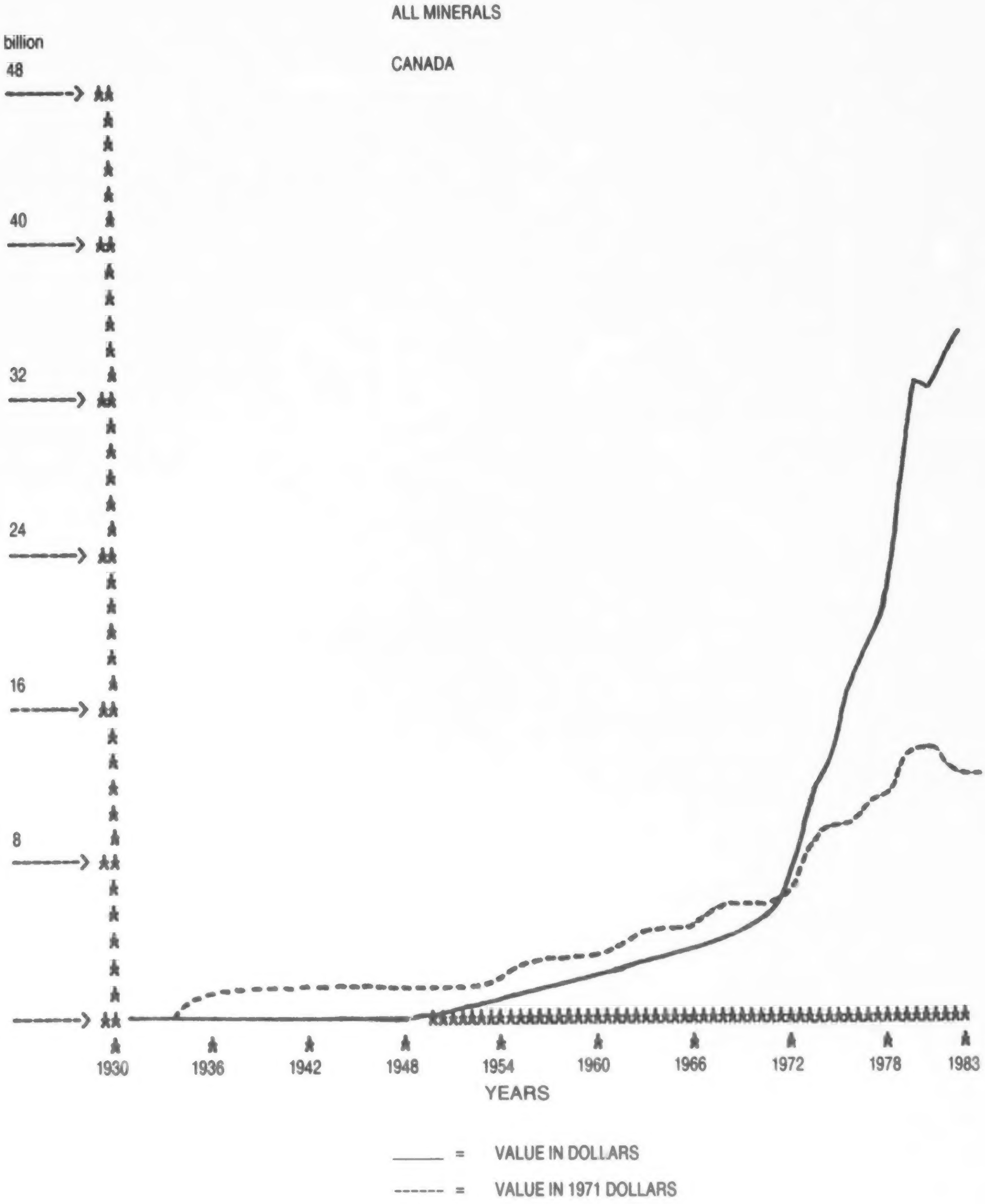
B. Gowganda	Metric Tons Silver	Nominal Value (millions of Canadian dollars)
1957	56.37	1.58
1958	67.68	1.89
1959	89.13	2.52
1960	86.04	2.46
1961	76.18	2.31
1962	70.34	2.63
1963	41.50	1.85
1964	49.06	2.21
1965	34.55	1.56
1966	38.87	1.75
1967	29.89	1.67
1968	34.20	2.54
1969	29.59	1.84
1970	12.43	0.74
1971	26.30	1.32
1972	28.76	1.54
1973-74	—	—
1975	0.15	0.02
1976	0.35	0.05
1977	0.05	0.01
Total	1,982.29	55.38

C. South Lorrain	Metric Tons Silver	Nominal Value (millions of Canadian dollars)
1908	0.41	0.01
1909	6.06	0.10
1910	6.88	0.11
1911	29.05	0.47
1912	25.94	0.48
1913	7.74	0.14
1914	3.37	0.06
1915	—	—
1916	2.40	0.05
1917	0.31	0.05
1918	2.25	0.07
1919	0.14	0.01
1920	0.26	0.01
1921	10.23	0.23
1922	39.95	0.87
1923	91.93	1.91
1924	81.90	1.78
1925	96.42	2.15
1926	94.70	1.89
1927	72.14	1.33
1928	35.27	0.66
1929	27.25	0.44
1930	54.86	0.78
1931	18.49	0.17
1932	0.69	0.01
1933-1934	—	—
1935	1.91	0.03
1936	0.36	0.01
1937	1.46	0.02
1938	1.25	0.02
1939	0.65	0.01
1940	0.36	0.00
1941	0.13	0.00
1942	0.31	0.00
1943	0.05	0.00
1944-1962		
1963	4.24	0.19
1964	2.91	0.13
1965	3.66	0.16
1966-1968	—	—
1969	0.02	0.00
Total	725.95	14.31


SILVER
ONTARIO
million
480
400
320
240
160
80
1930
1936
1942
1948
1954
1960
1966
1972
1978
1983
YEARS
______ = VALUE IN DOLLARS
------ = VALUE IN 1971 DOLLARS


SILVER
CANADA
million
1200
1000
800
600
400
200
1930
1936
1942
1948
1954
1960
1966
1972
1978
1983
YEARS
_____ = VALUE IN DOLLARS
------ = VALUE IN 1971 DOLLARS


ALL MINERALS
ONTARIO
million
4800
4000
3200
2400
1600
800
1930
1936
1942
1948
1954
1960
1966
1972
1978
1983
YEARS
_____ = VALUE IN DOLLARS
------ = VALUE IN 1971 DOLLARS


ALL MINERALS
CANADA
billion
48
40
32
24
16
8
1930
1936
1942
1948
1954
1960
1966
1972
1978
1983
YEARS
______ = VALUE IN DOLLARS
------ = VALUE IN 1971 DOLLARS

The great masses of nickel-copper ore in the Sudbury mines, consisting essentially of iron and copper sulphides and to a smaller degree nickel sulphides, are an important source of silver. For example, years ago the quantity of such ores put through the smelters from 1922 to 1935 inclusive, amounted to 23,070,556 tons, from which no less than 8,306,740 ounces of fine silver were extracted, a recovered grade of .36 ounces per ton of ore. The increased production of silver from these ores was doubtless due to the greater use of ore from the Inco Frood mine, which was much richer in silver than the average Sudbury mine.

Gold mines also yield their share of silver. Thus the diminished returns from the mines of the Cobalt area have to some degree been offset by these new sources of silver, which will become more important.

Silver is recovered from nickel ores in Ontario, e.g. at Inco's mines. Some Inco silver output was lost because of the shut-down. Both Falconbridge and Inco received 26 per cent to 35 per cent of their gross sales from the sale of co-products and byproducts mined with the nickel ore. (This proportion changed for Inco after acquiring ESB Ray-o-Vac Corporation, in 1974.) It is one of the major reasons why mining of the Sudbury ores is viable. Higher international precious metal prices are reflected in the sharply escalated values of the by-product precious metals such as silver mined at Sudbury, Ontario.

Inco's output products as by-product about 42 metric tons of silver in a typical year. Inco's sales of silver have been:

Inco Silver	**1981**	**1982**	**1983**
(metric tons)	46.96	32.66	19.28

A large part of the normal output of newly mined silver from Inco and Falconbridge in Ontario was lost in 1982/83 due to nickel market related shutdowns.

Inco Ltd. recently adapted multi-million dollar gold and silver refining facilities in Ontario so that virtually every ounce of its mine output of by-product silver and gold is refined in Ontario.

Inco is exploring for both gold and silver in both Canada and the Western U.S.A.

A small part of Ontario production used to come from small relatively high-cost mines in the Cobalt area and one company in particular is still producing.

These have been among the richest silver ores in North America. Veins carrying masses of native silver weighing up to 726 kilograms have been exposed on the surface. The small Cobalt, Ontario silver mines were operating, at best, near a break-even point of about $11.00 per ounce Canadian for silver in the early 1980's.

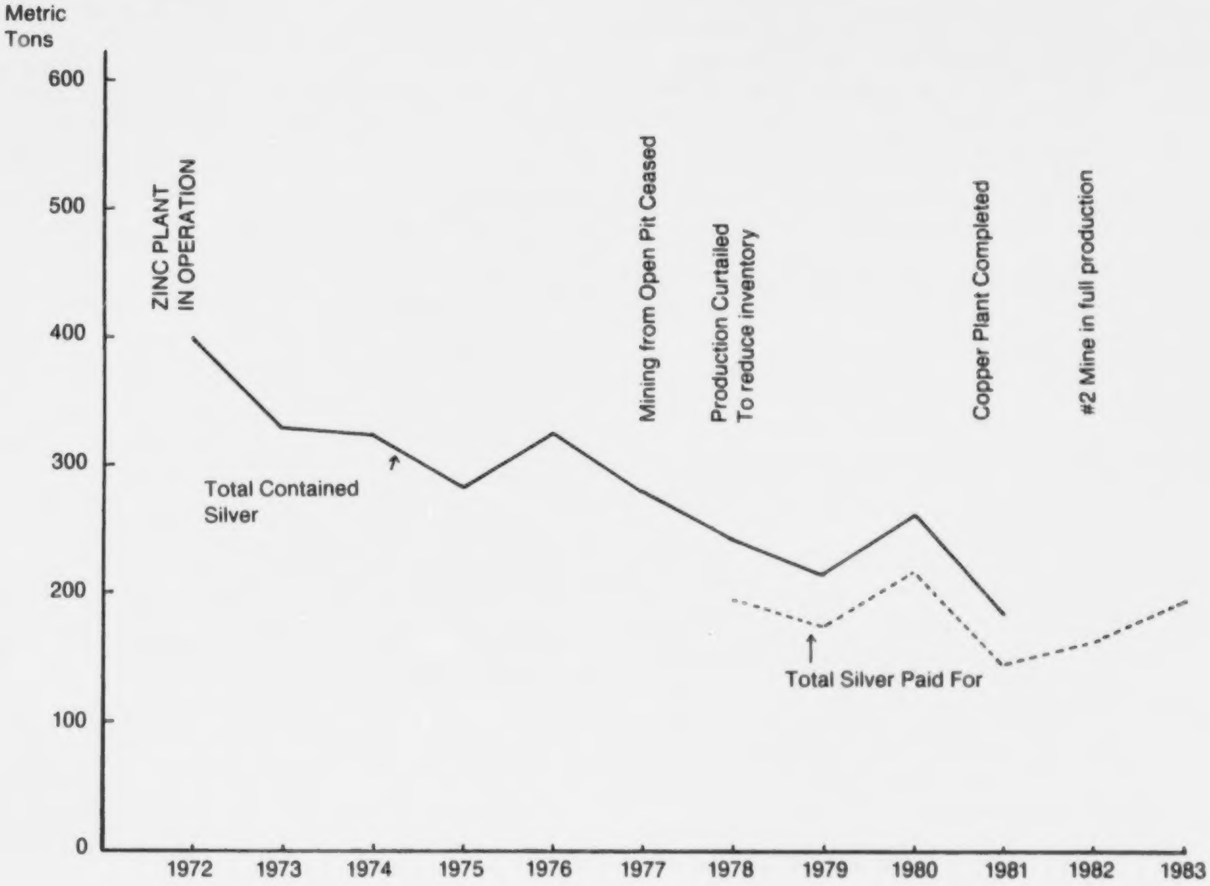
Similar deposits are found at Gowganda, Ontario and Annaberg and Schneeberg in Saxony, East Germany.

The main operator at Cobalt, Ontario is Agnico-Eagle Mines Ltd. (Ag-Ni-Co denotes silver-nickel-cobalt) led by the highly successful entrepreneur, Paul Penna.

Agnico-Eagle properties in the Cobalt area include twelve of the most famous mines, which collectively produced about 6,730 metric tons of silver between 1904 and 1922.

Agnico-Eagle expected to produce 31 metric tons of silver in 1984 and the Silver Division is expanding. However, output was already 34.4 tons of silver for the first three quarters of 1984, more than double that of the same period in 1983. It has overtaken Inco in silver output, perhaps permanently. 1983 Agnico output was 24 metric tons of silver and 1982 output was 17 metric tons of silver. With Silver Century, it is doing underground development at Cobalt to earn a 50 per cent interest.

KIDD CREEK MINES LTD. - SILVER PRODUCTION



The company holds a stockpile, amounting to about 14 metric tons of silver early in 1984, worth perhaps U.S. $3 million, but presumably it will wait for a much higher price for silver before selling any or all of the stockpile.

Agnico-Eagle now owns the silver refinery at Cobalt, Ontario.

Agnico-Eagle's average output costs in 1983 were under $6.00 an ounce. Agnico-Eagle's production break-even point was $8.00 per troy ounce (U.S. $5.84 an ounce in 1983), so it has been in a comfortable tactical position compared to many mines.

Agnico-Eagle's silver division in Ontario employs only about 194 persons and its lean management is greatly admired all across North America.

The company has no debt, which makes it almost unique. It is spending about $1.5 million for developing silver properties alone.

The mining of silver from silver-cobalt ores has been continuous since 1905 in the area of Cobalt, Ontario. Silver production in Ontario peaked in 1911 at 979 metric tons and declined steadily until 1949. Cobalt's silver output peaked in 1910 at 936 metric tons.

With the start of the Korean War in the early 1950's, the U.S. Government contracted for the purchase of cobalt concentrates from the Cobalt area. Deloro Smelting and Refining at Marmora, Ontario processed the concentrate under another contract. The production of these cobalt concentrates brought new life into the Cobalt camp. Cobalt production in concentrates soared to annual levels of over 1.25 million pounds in 1954 and 1955. However, new cobalt sources were discovered elsewhere and the U.S. government cancelled the contract which had been extended to 1958. Cobalt production virtually ceased in 1958. Effectively there has been no market for cobalt from the Cobalt area since that time because of more economically competitive mines in Africa.

On the other hand, annual silver production in concentrates at Cobalt, beginning in 1956, climbed from 120 metric tons a year to levels of 155 to 186 metric tons in the period 1958 to 1968, before dropping sharply below the 93 metric ton level in 1971 and to below 30 tons in 1975.

During the period 1971-1975, because of increased mandatory environmental constraints on smelter emissions, Canadian smelters/refineries refused to accept Cobalt silver mine concentrates, which contained high arsenic contents. The mines were granted exemptions by Cabinet under Section 113 of The Mining Act and sold the concentrates abroad in order to preserve mining jobs.

Silver production again began to climb until 1978 when a sharp increase in the treatment and refining charges in the local refinery contract reduced the returns on silver to the mines. Silver production in concentrates in 1980 declined to about 36 metric tons from 84 metric tons in 1978 even though silver prices increased to over U.S. $20 per ounce.

Direct calculation of even probable ore reserves in the Cobalt area is virtually impossible, principally because of the erratic nature of the silver-cobalt deposition and the lack of cobalt assays on drill core intersections. However, annual statistics on approximately 95 per cent of the concentrates produced in the area appear to indicate that optimum results from the mining of Cobalt area cobalt-silver ores will only be achieved when silver and cobalt can both be explored for and mined as payable metals.

Further, it is considered that, if there were to be a combination of much higher international metal prices and lower interest rates in future, reasonable returns on both silver and cobalt and a satisfactory exploration and development effort on the scale of that in the early 1950's could reasonably be expected.

The Timmins area of Ontario has complex ores from which both gold and silver are recovered.

Mines producing silver, even as a by-product, will also benefit enormously from the expected boom in silver. This would flow to a number of mines in Ontario.

A joint venture agreement between Noranda and Massive Energy Ltd. on a silver-gold prospect in the Favourable Lake area, some 200 kilometres north of Red Lake, NW Ontario has been studied. Reserves to date grade 274 g. silver per ton.

In the Gowganda area, NE Ontario, Manridge hit several high grade veins some 100 feet below the surface. One hole graded 506 ounces of silver per ton.

VOLUME OF OUTPUT — ONTARIO PRECIOUS METALS

The production of silver from Ontario mines increased annually to a peak of 979.74 metric tons in 1911 and then began to decline gradually. 1982 output was 347 metric tons.

Silver production from Ontario mines in 1984 is expected to exceed the 1983 production of 347 metric tons, preliminary.

Ontario's volume mine production of gold peaked as far back as 1940 at 101.45 metric tons, compared to the 1982 Ontario output of 20.14 (revised) metric tons of gold.

Ontario has three of the five leading gold mines in Canada and the about-to-produce Hemlo gold field, potentially the largest gold orebody in North America.

The top five Canadian gold-producing mines in 1984 should be:

		(metric tons of gold)
1)	Campbell Red Lake, Red Lake, NW Ontario	6.7
2)	Lupin mine, Echo Bay Mines, Northwest Territories	5.5
3)	Doyon mine, Lac Minerals, Quebec	4.9
4)	Dome Mine, NE Ontario	3.6
5)	Detour Lake, NE Ontario	n.a.

Detour Lake grades about 0.15 ounce silver per ton.

Ontario gold mine operating costs vary considerably relative to present gold prices. Direct costs, not including interest charges, rose between 20 and 35 per cent in 1982-83, according to analysts. These costs ranged from a low of about Canadian $125 per ounce to a high of Canadian $545.50. Two of the major Ontario mines, when interest charges are included, have costs well over a Canadian price of $450. per ounce of gold.

The silver content of the new Hemlo gold mines may be between 1 and 2 g. per metric ton.

For the present, gold appears to be one of the best bets for concentrated efforts in Ontario government policy stimulation in the immediate future as pay-off periods are liable to be achievable much sooner than for base metals. Furthermore, as mentioned above, a high level of activity in gold prospecting and development often has led (and in future may be expected to lead) to significant base metal discoveries such as copper, lead and zinc, which often have high silver contents.

VALUE OF OUTPUT — ONTARIO PRECIOUS METALS

VALUE OF ONTARIO'S MINE OUTPUT OF PRECIOUS METALS

(CLOSE TO $1 BILLION IN 1980)

Ontario is Canada's leading gold-producing Province and contributes to making Canada the world's third largest mine producer of gold, after South Africa and the U.S.S.R.

Ontario is the world's third largest mine producer of platinum group metals.

Each year, Canada has vied with Mexico, Peru and the Soviet Union for the position of the world's largest mine producer of silver and Ontario is normally the leading Canadian Province in silver output.

A proportion of the Province's gold and platinum group metals and an important part of the silver output arises as a byproduct of base metal mining. Since 1960, between 8 and 23 per cent of the value of the total output of all metals recovered from ores from Ontario's mines has consisted of the eight precious metals (gold, silver, platinum, palladium, rhodium, iridium, ruthenium and osmium).

IN 1983, ABOUT 23 PERCENT OF ONTARIO'S METALLIC MINE PRODUCTION VALUE WAS PRECIOUS METALS. THIS PERCENTAGE OF TOTAL VALUE WAS JUST OVER 8 PER CENT IN 1976 AND HAS RISEN SHARPLY SINCE THEN.

The total value of Ontario's mineral output from mines, pits and quarries in 1980 jumped by over 40 per cent, ($1.38 billion), to a record $4.66 billion, compared to the $3.276 billion mined in 1979.

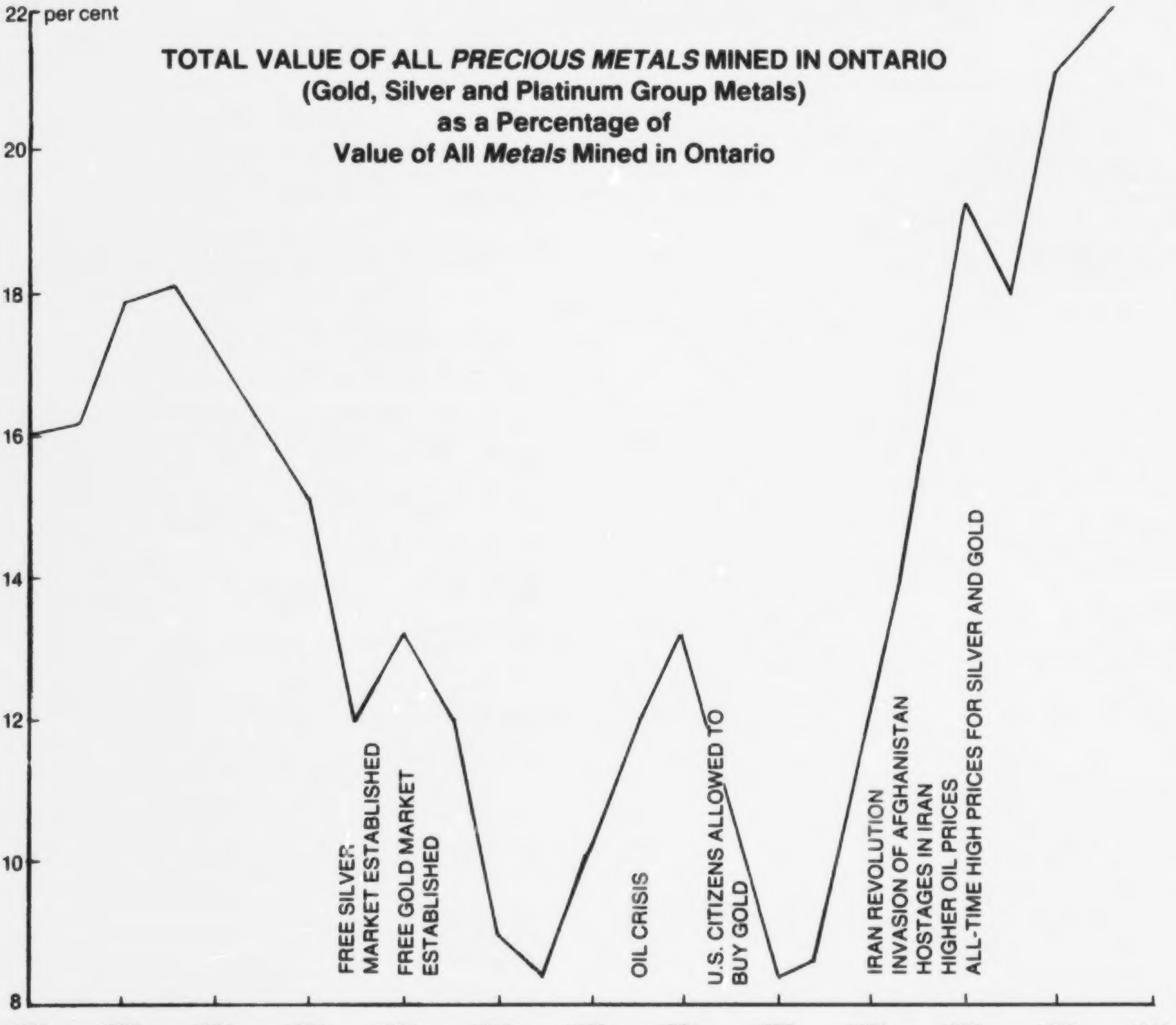
A GREAT AMOUNT OF PUBLICITY AND ATTENTION IS GIVEN TO GOLD IN ONTARIO AND CANADA GENERALLY, BUT, IN ONTARIO, THE TOTAL VALUE OF NEWLY MINED SILVER HAS BEEN CLOSE ON THE HEELS OF GOLD IN RECENT YEARS.

Gold mined in Ontario in 1980 was valued at a record $404 million with silver close at $336 million. 1979 gold output had been $221.5 million and silver $171.8 million. The value of the other precious metals mined, (the platinum group metals), was an estimated $159 million in 1980 and $56 million in 1979 — almost tripling the value in one year.

Deliveries of precious metals from companies mining in Ontario were valued at:

$900 million in 1980
$450 million in 1979
$308 million in 1978
$261 million in 1977
$211 million in 1976
$247 million in 1975
$247 million in 1974

Ontario's total annual mine output value of the eight precious metals had been similar to the Province's total iron ore production value up until 1978. In 1979 it was over the iron production value and in 1980 nearly 3 times. Until 1976 precious metal output values were about the same as the copper production value.



TOTAL VALUE OF ALL *PRECIOUS METALS* MINED IN ONTARIO
(Gold, Silver and Platinum Group Metals)
as a Percentage of
Value of All *Metals* Mined in Ontario

N.B. The Value of All Precious Metals Mined in Ontario in 1980 was Almost $900 Million.

In constant 1983 dollars, the highest unit value this century of Ontario mine production of silver and gold came in 1980. The prices were so strong in 1980 that, although the volume of Ontario mine output of these metals that year was considerably lower than the peak years, the total value of silver and gold output respectively (expressed in constant 1971 dollars), was the highest ever for silver at $150.68 million and was the highest for gold in "real" dollars since 1943, ($211.19 million).

1980 mine output value of gold was not much higher than that of Ontario's newly mined silver that year.

In terms of constant 1982 dollars, the lowest unit value this century of Ontario mine production of gold came in 1971.

However, in the same terms, the lowest unit value of Ontario mine production of silver came as long ago as 1931, forty years before 1971. Then silver was, (in 1982 dollars), $83 per kilo as compared to $314.34 in 1982 — surely a better percentage growth record in real value than that of gold over that period. Silver's real gain was 2.7 per cent per annum compounded annually. In 1982 dollars, Ontario gold bought $5.83 per gram in 1931 vs $14.84 per gram in 1982, (a gain of 1.9 per cent per annum compounded annually).

Silver is perhaps the one metal for which a slightly rising real price trend through the second half of the decade is more likely than for any other. This would be subject to major downward correction if photographic film not requiring silver comes into use on a large scale. Increased uses of silver on the other hand are occurring in the area of water-purification and other catalyst applications.

Formalized forecasting of the silver market is virtually impossible for the reasons that

(a) silver is produced primarily as a by-product of output of other metals and

(b) silver plays in many countries a monetary role as a store of value of last resort, exceeding in several countries even the role of gold. India and South-East Asia constitute a vast reservoir of silver hoards from which supplies flow when prices are high and into which they disappear when prices are low. Even in the West the secondary supply from silverware, hoards and heirlooms can be significant under appropriate economic conditions. All this can exert significant influence in silver price movements.

With regard to the future of silver in Ontario, the only thing that is certain is that total revenue from silver values in polymetallic sulphides would tend to provide a better cushion against the fluctuations in other metal prices than any one of most other co- or by-products, except perhaps gold.

5. WHAT THE ONTARIO PROVINCIAL GOVERNMENT PROVIDES TO ENCOURAGE MINERAL INVESTMENT AND DEVELOPMENT

Present figures indicate that 1983 goes down as a very active year for mineral exploration and development in Ontario. There has been a great deal of renewed interest in gold mining and quite a bit of this increased activity is taking place in northern Ontario. It encompasses exploration, reactivation of closed mines, development of some new mines and significant expansions of existing mines, particularly gold mines.

Many of these properties contain by-product silver.

Of course, in looking for gold, some explorationists find base metal deposits which contain silver. Expansion programs went ahead apace also in uranium and at the Kidd Creek mine, the large copper-zinc-silver/gold-tin producer in the Timmins area.

The key to the future of Ontario's mine output of silver lies in the amount by which the silver price rises, reflecting the levels of usage and the total world mine output of new silver, (particularly as a by-product of base metal mining), modified by the rise and fall of stocks of refined silver and of the supply level of scrap sources of silver. The question of the release to market of the 4,043 metric tons in the U.S. G.S.A. (General Services Administration) stockpile of silver remains unresolved, but it is a bearish factor for the silver price.

How does the Ontario government go about doing its part to bring investment in minerals to Ontario, since capital investment in the Ontario mining industry is essentially externally determined? Well, here is an outline.

The overall policy goal of the Ministry of Natural Resources of the Ontario Government is:

> To provide opportunities for continuous economic and social benefits to the people of Ontario through the development and conservation of Ontario's natural resources, which includes programs to implement this policy with respect to minerals for
>
> (1) promoting the orderly development of the Province's mineral resources;
>
> (2) maintaining a health and growing mineral sector and
>
> (3) securing for the people of Ontario the maximum economic and social benefits from the development of the Province's mineral resources.

One major objective is to encourage the investment of private capital for exploration and development and another is to promote further domestic mineral processing. All of this creates new jobs or protects the current level of employment in Ontario mines, quarries and processing plants.

Other objectives are to minimize adverse investment effects of policy formulation by all levels and agencies of provincial, federal and municipal governments and to help industry to anticipate changes in market factors which bear on the investment climate.

The Ministry of Natural Resources publishes its in-depth policy analyses and a supporting array of facts on minerals important to Ontario. It provides geological mapping and support services which, while supportive of the whole industry, make it possible for the individual and the small company to compete in the discovery process.

It also promotes mineral resource development through the Ontario Mineral Exploration Program (O.M.E.P.), which provides financial incentives towards exploration activities in Ontario for non-producers and there are also mineral taxation incentives for producers.

The huge capital requirements for new mines and mineral processing plants pose an enormous challenge:

(1) to the mineral industries

(2) to governments

(3) to the capital markets and especially

(4) to the Junior Mining sector.

The mineral industry has always been "long-term" oriented because of the high cost of exploration and the capital-intensive nature of mining and because of the complexity of reducing the ores to saleable metals and other forms. All this means long lead times from exploration to production — which in recent times have been extended by a plethora of regulations. Longer lead times mean higher costs of capital. Lead times today are much longer and mine life typically much shorter today than even a generation ago.

Apart from capital costs, labour costs have moved quite a way from the category of variable costs into the category of fixed costs. The exhaustible character and location-bound nature of mineral resources in situ pose additional problems. In the longer term, the mineral supply position will be controlled by the rates of exploration and discovery many years before new mines can come into operation. These rates in turn depend on the after-tax return of capital expected at those early stages. Long lead times from feasibility study to startup of production compound the problem.

The establishment of stable, consistent and balanced government policies is as crucial to success in mineral growth as to technological progress itself. The long-term stability of mineral, fiscal and labour policies, both provincial and federal, is an essential requirement for a healthy and vigorous mineral industry and for the planning and financing of exploration and development. Both are essential for long-term mineral resource development.

Mineral policies do not and cannot exist in a vacuum. Practical coordination is needed between various policy-making units in government to avoid the creation of conflicting objectives.

It is obviously desirable that there be consultation between Ministries on policy formulation on anything which affects mineral, labour and fiscal program evolvement so that the actions of government and industry on minerals are mutually reinforcing.

Policies must be initiated or revised on a continuous basis for small as well as large problems. Valid objectives must be set so that all parties with a role to play can move in the same direction. Furthermore, policies must be accompanied by the creation of adequate mechanisms with which to apply them and then to audit the results.

Specifically, *the Government of Ontario provides:*

(1) A reasonably free enterprise environment for mineral investment. The Ontario government does not own or operate any mines and is not in the business of running mines or mineral processing plants.

This position helps to ensure further growth in mining and smelting ores and refining metals in this Province, because it encourages entrepreneurial exploration here and thus expands our resource base.

(2) To individuals and non-mining companies, direct government grants or tax credits for mineral exploration — under O.M.E.P., (Ontario Mineral Exploration Program).

The Ontario Mineral Exploration Act, 1980, and regulations made thereunder came into effect on September 1, 1980.

This Act provides incentives for the exploration of mineral resources in Ontario by providing grants equal to 25 per cent of the amounts spent on eligible mineral exploration in Ontario by individuals, residents in Canada and those not engaged in nor associated with mineral production in Ontario, who undertake or invest in mineral exploration activities; also by providing income tax credits equal to 25 per cent of the amounts spent by eligible companies on mineral exploration. Unused tax credits in any year will be refundable to exploration companies and may be carried forward by companies not principally engaged in mineral exploration.

The budget allocation for 1984-85 was $5,000,000 in grants or tax credits based on eligible expenses of $20,000,000.

The maximum grant or tax credit for any one designated program was set at $250,000 initially and later increased to $500,000. The program is presently under review to determine future funding levels and conditions which will promote the most effective support of mineral exploration in Ontario.

One thousand and eighty (1,080) applications representing an estimated expenditure of $267 million were submitted to OMEP from its inception on September 1, 1980 to the end of March, 1984. Of these, 830 programs were designated for total expenditures of $194 million. Eighty-five (85) per cent of these expenditures are for exploration for precious metals, including silver. Approximately 25 per cent of the expenditures are for advanced programs leading to potential production. Over 90 per cent of the expenditures are in Northern Ontario, with the remainder in Eastern Ontario.

The Mining Taxation and OMEP Office of the Ministry of Natural Resources processed and audited 423 completed programs with total expenditures of $69 million and issued $13.7 million in grants and tax credits by the end of March, 1984.

The following programs have resulted in providing significant contribution to Ontario:

* Two of the three Hemlo gold-silver discoveries funded under OMEP are being prepared for production in 1985-86.

* OMEP contributed to the Sturgeon Lake and Cameron Lake discoveries, both of which generated record high activities;

* Scadding Mine in the Sudbury area represents the first OMEP-assisted project to be brought into production, at a rate of 200 tons per day of gold ore.

* Underground development is proceeding on three major silver properties assisted by OMEP.

The OMEP-assisted programs completed to March 31, 1984 have generated over 175,000 man-days of employment and almost 1,200,000 feet of diamond drilling. OMEP provides an incentive for vital activities resulting in new mine development, creation of jobs, and regional econmic development, particularly in Northern Ontario.

In short, the new OMEP Act is a vital application of policy that is resulting in new mine development, creation of jobs and regional economic development, particularly in Northern Ontario.

3) Funding for research into certain difficult metallurgical problems, e.g. the study that was done on the extraction of cobalt from complex silver ores in the Cobalt area in Northeast Ontario.

4) FINANCIAL INCENTIVES TO PRODUCERS:

The Mining Tax Act provides a number of financial incentives to mineral producers in Ontario. The Act encourages mineral producers, who invest capital for exploration, development, new mine openings, or expansion of existing mines and processing facilities. These features strengthen the base of Ontario's mining industry by encouraging private sector investment in exploration and development and as a result, provide increased economic benefits and jobs to Ontario.

The Mining Tax Act is a profits tax on Ontario mines. The tax is assessed on the profits made out of the value received for the output of the mine at the pit's mouth, as determined in accordance with the provisions of the Act. In order to encourage small mining companies, as well as large mining companies, the Mining Tax is levied on the mine profits using a graduated rate schedule, with a maximum rate of 30 per cent.

In brief, the Act offers the following incentives to producing companies:

- No taxes on profits of less than $250,000 in a year. This is an effective incentive to small and marginal producers, who often provide the only major source of employment in isolated northern communities.

- Lower tax rates for new mines or major expansion of existing mines. This incentive encourages existing producers to develop new mines or expand existing facilities within the Province.

- Exploration development and pre-production mine expenditures incurred in Ontario are 100 per cent deductible in computing profits subject to mining tax. These write-offs again illustrate the support offered by Ontario to create attractive investment opportunities.

  Producing companies in Ontario are allowed to write-off or deduct 100 per cent of mineral exploration expenditures. This allows companies to recover:

  up to 30 per cent under the Mining Tax Act; 9 per cent under the Provincial Corporate Income tax; and 36-48 per cent under the Federal Income Tax Act.

  Thus, three quarters or more of exploration expenditures are recovered by producers, which means that 13-25¢ on each dollar spent is the cost to producers.

- Depreciation on mining plant, equipment, machinery and buildings is allowed at an annual rate of 15-100 per cent of the original cost of the assets, (30 per cent in the case of new mine assets acquired after April 1, 1974 and 100 per cent for mine assets acquired after March 7, 1978 for use in a new mine or major expansion of an existing mine.) This serves as a further incentive to encourage the expansion and modernization of mining operations in Ontario.

- Processing Allowances: It is the policy of the Government of Ontario that minerals produced in the Province shall be processed to as advanced a degree as is reasonably possible before being exported from Canada. It is also Canadian federal policy. Thus, depending upon the size and location of the new processing facility, 8 per cent to 30 per cent of the capital expended in establishing the facility may be deducted from the profits on which the Mining Tax is assessed. This processing allowance cannot be less than 15 per cent nor greater than 65 per cent of the combined mining and processing profit, under the so-called 15/65 rule. The processing allowances or deductions from the Mining Tax are among the most generous in the world and are designed to keep gold and silver mines and other mines alive in years when world metal prices, and therefore mine profits, are low.

5) CUSTOM GOLD MILLING FACILITIES — CAPITAL GRANTS

The Premier of Ontario, the Honourable William G. Davis, announced in January, 1981, a new program called BILD, (Board of Industrial Leadership and Development), which includes the following:

a) **Custom Gold Sampling and Milling Facilities:**

Development of small gold deposits and mining of lower grade ore are activities that have been constrained due to the lack of proper sampling, test milling and milling facilities. These deposits sometimes contain silver. The key problem in the expansion of small gold mine activity is the availability of milling capacity. This situation constituted a true bottleneck. To overcome these constraints,

i) Ontario provides capital assistance to private entrepreneurs to establish test custom gold milling facilities for bulk sampling purposes and the milling of small lots.

ii) Ontario also will provide, where necessary, a reference assaying service to assure the validity of grade determination and test milling results.

Such facilities are in place at Sioux Lookout, Beardmore and an installation is being made at Timmins. The provision of additional facilities in other locations will depend on demonstration of a need.

b) A similar Small Rural Industrial Mineral Development Program.

c) Drill Core Libraries Program of the Ontario Geological Survey.

6) In the Mineral Resources Branch, original research and analysis along several lines allows quantified assessments of the impact upon the mineral industry of changes in commodity markets and governmental policy factors.

7) Communication of findings on mineral matters, e.g.

a) books and published accounts, written mainly by Mineral Resources Branch staff, on individual commodities mined in Ontario, for example Gold, Platinum, Nickel, Zinc, Uranium (and now Silver), in their world setting, with the mineral policy implications for Ontario. Also contributions on metal commodities to books published in the U.S. and U.K.

b) authoritative papers on the mineral economics of the impact of mandatory environmental equipment costs on mining operations etc.

c) oral presentations to national and international audiences, e.g. Canadian Institute of Mining and Metallurgy (CIM), the International Precious Metals Institute (IPMI), the Silver Institute and University lectures and seminars.

d) participation in mineral-related intergovernmental negotiating groups, e.g. United Nations Law of the Sea (UNCLOS) Treaty 9-year negotiations, the Intergovernmental 6-nation and multination negotiations on a truly international Nickel Information organization, Federal/Provincial Task Forces, etc.

e) appearances on national network television and radio and at Chambers of Commerce and miners' union locals, discussing metals vital to Ontario such as gold, silver, nickel, the platinum group metals etc.

8) **Geological Mapping and Services**

The Ontario Geological Survey (O.G.S.) is headed by the Director of the Survey, who reports to the Executive Coordinator of the Mineral Resources Group of the Ministry of Natural Resources.

The Ontario Geological Survey, with the assistance of the MNR Regional and Resident Geologists in the Regions of the Ministry throughout the Province, has contributed to the discovery of many metal occurrences and mines in Ontario by its activities. Each year it aids the mineral industry by publishing geological maps and reports, conducting seminars and presenting papers on the geology and mineral deposits of Ontario, providing consultation to industry geologists, and conducting a prospecting course.

Reconnaissance and detailed geological, geophysical and geochemical surveys are directed toward unravelling Ontario's complex geological history and assessing our mineral resource potential. The results of these surveys are shown on the more than 150 maps published each year by the O.G.S. and are explained in our various reports.

Minerals deposit data files are continuously updated. These contain concise up-to-date information on the location, geology and mineralogy, history of development, ownership, economic features, and production (if any) from Ontario's known mineral deposits.

Several files have been transferred to a computer retrieval system. Currently three files are accessible by computer:

> firstly, a mineral deposit inventory to 5,500 mineral occurrences and deposits in Ontario;
>
> secondly, a geoscience data index to the more than 6,500 O.G.S. reports and maps published since 1891, plus some 8,500 Ontario exploration reports submitted by industry; and
>
> thirdly, rock chemical data for more than 9,600 rock samples collected by O.G.S. geologists.

9) In addition to the regular on-going survey projects of the O.G.S., several special field surveys and projects are carried out each year in Ontario. Funded by other agencies of government, but managed by the O.G.S. and the resident geologists, these special survey projects involve expenditures of several millions of dollars a year. During 1983, 20 such special project surveys were conducted under six programs.

The special Kirkland Lake Incentives Program (KLIP) entered the fifth year of its five-year program in 1983. It is managed by the O.G.S., but funded equally by the federal Department of Regional and Industrial Expansion (DRIE) and the Ontario Ministry of Northern Affairs. The staking rush that resulted after the release of the geophysical results in 1979 was followed by a steep rise in exploration activity in 1980, which is still strong.

KLIP aroused most encouraging interest in the mining community and led to several similar programs being established for other areas of Ontario; the Black River Matheson (BRIM) funded by the Ministries of Natural Resources and Northern Affairs and the Opapimiskan Program funded by the Ministry of Northern Affairs.

Another special program, which moved into its fifth year in the summer of 1982 was the Northern Ontario Geological Survey (NOGS) program; funding by the Ontario Ministry of Northern Affairs. In this program, a variety of geo-commodity studies and community-based projects are designed to stimulate mineral exploration and to provide data for land use planning. Special attention was given to the Atikokan, Cobalt-Gowganda, Sudbury, and Manitoulin Island areas.

Also, currently underway are the special programs of the Southeastern Ontario Geological Survey (SOGS), the Hydrocarbon Energy Resources Program (HERP) and those sponsored by the Northern Ontario Rural Development Agency (NORDEV).

10) Production of geological reports and studies on mineral matters e.g.

geoscience maps showing geological, geophysical and geochemical distributions.

authoritative geological survey reports, papers and studies for the stimulation of exploration and land use planning.

the Northern Ontario Engineering and Terrain Studies and maps covering some 400,000 square kilometers.

11) Managing research grant programs. The Ontario government's Geoscience Research Grant Program entered its seventh year in 1984. Its mandate is to make private mineral exploration easier and to assist the Ministry's earth resources program through geoscience research in Ontario universities. The Exploration Technology Development Fund began its fourth year in 1984. This latter fund benefits applied research and development that leads to the manufacture and marketing of equipment, techniques and facilities which will support mineral exploration.

Each year, summaries of research carried out under these programs are published for the annual OGS Geoscience Research Seminar and Open House. The 1984 seminar, held in December, attracted great interest as shown by a registration of 760 persons compared to 742 in 1983. The 1984 attendance was the highest ever.

12) **Other Support**

Continuous work is being carried out on improving road access to Northern Ontario mineral resource areas. Through its ministries of Treasury, Transportation and Communications, Northern Affairs and Natural Resources, the Province of Ontario has the means to contribute to the resolution of some infrastructure and other access problems.

These twelve initiatives hopefully should give Ontario an even large share of Canada's silver and gold output eventually, in spite of expansions and openings in other Provinces. These contributions — on a continuous basis — lead to more new mineral discoveries and mine developments.

Investment Climate

The mineral industry worldwide thrives best in a climate of cooperation among different disciplines, governments, countries, investment sources and industry sectors and with the assistance of the fields of academic research and the information networks.

There will, in fact, be fierce competition between mineral-rich jurisdictions for capital sums for mineral projects. A great deal will depend *not* on the real situation in Ontario, but on the investor's *perception* of Ontario (or anywhere else) as a place in which to risk these huge sums; *only then* can new jobs begin to be created.

Exploration dollars, unlike mines, can move to other countries and provinces. To maintain the flow of funds necessary for the development of its mineral resources, Ontario must continue to impact on this investor world with imaginative proposals supporting and reinforcing the long established image of a safe haven for investment in minerals.

Quebec

The Abcourt-Barvue silver-zinc prospect of Les Mines d'Argent (Silver Mines) Abcourt in Barraute township, 34 miles northeast of Val d'Or grades 5.07 ounces of silver per metric ton and may get into production soon. Additional surface and other drilling indicates that silver grade in the ore reserves may be higher at 300 feet than indicated by surface drilling.

Gold mines such as Bousquet, Chadbourne, Copper Rand and Lemoine have produced some silver.

The newly-mined silver output of Quebec is mainly the by-product of base metal mining, however.

The leading silver producer is a relatively new copper mine, Les Mines Selbaie, a subsidiary of Selco Inc. of Toronto, Ontario, owned by Selection Trust, London. It has produced over 14 metric tons of silver a year.

Les Mines Gallen (Noranda 51 per cent; MacDonald Mines 49 per cent), was a copper-zinc-silver producer.

Lemoine Mines of Northgate Exploration and Madeleine Mines shut down permanently.

Other silver producers are Agnico-Eagle Gold Division, Camchib Resources, Corporation Falconbridge Copper, Mines Gaspe, Noranda Matagami, Sigma and Teck Val d'Or.

Maritime Provinces

Brunswick Mining (Noranda 64 per cent, with Selco and Hudson's Bay Oil and Gas), in New Brunswick Province was the main source of Maritimes silver output in 1983. It was second largest mine producer of silver in Canada in 1982.

The Consolidated Rambler Mines operation in Newfoundland also produces silver.

Manitoba/Saskatchewan

Silver output continues to arise as a by-product of base metal mining by Hudson Bay Mining and Smelting, (owned by Anglo-American Corporation of South Africa), at the Flin Flon mine, on the Manitoba/Saskatchewan border and at Snow Lake and by Sherritt Gordon Mines at the Fox and Ruttan mines.

Silver output from the Flin Flon-Snow Lake area in 1983 was some 29 metric tons, compared to about 31 tons in 1982.

Agassiz Resources, Lynn Lake and Inco Ltd. also produce silver and other precious metals.

British Columbia

British Columbia currently mines more silver than any other Provinces, 411 metric tons in 1983, 458 tons in 1982 and 402 tons in 1981.

Canada's single largest mine producer of silver, the rich Equity Silver Mines Ltd., Sam Goosley Mine, Main Zone and Southern Tail open pit, Houston, British Columbia, contributed C.$21 million to Placer Development, Vancouver, British Columbia, in 1983. Mining has moved over to the Main Zone. Placer owns 70 per cent and designed, built and manages the property. Equity owes Placer $68.3 million. Output in 1983 was 154 metric tons of silver and up to one ton of gold. Silver output in 1983 was lower than 1982 because the higher silver price enabled lower grade ores to be mined. The Main Zone was developed for transfer of mining operations late in 1983, taking over from the Southern Tail pit. Grade in 106.4 g. silver per metric ton. A new $12.5 million scavenger circuit came on stream in October, 1984. Output of over 156 tons of silver is expected in 1985. 70 per cent of Equity's revenue is from silver.

Production costs were U.S.$8.40 an ounce of silver in the first half of 1983 and have risen since. The concentrates go to Japanese smelters for refining.

The new U.S.$225 million "HW" mine expansion of Westmin Resources has been delayed by a strike, but should produce at a rate of 31 metric tons of silver a year in the second half of 1985. Grade is 1.1 ounce silver per ton. Start-up in 1985.

Cominco's "Sullivan" mine continued to produce silver and operated normally in 1983, with an output of about 120 metric tons of silver.

Development is on hold at the Torbrit property of Dolly Varden Minerals, which grades 10.96 ounces of silver per ton. U.S.$15 an ounce may be needed before output commences.

Scottie Gold mine at Stewart has some silver.

Dankoe Mines, Teck Corporation, Beaverdell, Lornex, Newmont and Bell Cooper also produce silver.

At its Silvana mine near Sandon, B.C., now shut down, an additional block of ore grading 15.4 ounces silver may be mined out in 1985.

Yukon Territory, Canada

On the border between British Columbia and the Yukon, (Watson Lake district), Canada, drill results from the Midway property, 51 per cent owned by Regional Resources Ltd. (in which the Hunts of Texas are said to have an interest) suggest a sizeable high grade silver-lead-zinc deposit, with grades of 390 g. and 481 g. (say 11.5 Troy ounces) per ton estimated. Canamax Resources (Amax) and Procan Exploration are the other shareholders, holding a 49 per cent interest. Silver reserves are conservatively estimated at between 1,150 and 1,340 metric tons. A major underground development program is under way to determine mining and other characteristics. The gross value of the ore may be approaching C.$300 a ton.

United Keno has been the main silver producer with the Elsa, Husky and Ruby silver-lead mines in the Keno and Galena hills. Falconbridge Nickel owns 48.42 per cent. Closed indefinitely 1982. Resumed operations in August, 1983 at a reduced rate. Mill head grades are about 25 ounces of silver per metric ton. Silver recoveries are about 86 percent. Silver output about 37 metric tons in 1982.

At end-1983, reserves totalled about 200,000 tons grading 27.3 ounces per ton and another 170,000 tons grading 27.6 ounces per ton.

Full year 1983 output was 19.7 metric tons of silver, down sharply from 1982. The 1984 target is 37 tons. Output costs in 1983 were $10.49 an ounce.

In what is described as an unprecedented push in exploration in the next two years, United Keno has started a multi-million dollar major underground and surface exploration program for the second half of 1984, searching for more silver. A block at Ruby grades 26 ounces of silver, with reserves at Husky at 22.6 and 23.5 ounces and at 34.8 ounces at Silver King.

The non-operating Venus silver-gold property near Carcross, which had reopened in 1981, has United Keno working underground in 1984.

Dawson Eldorado Gold Explorations plan to produce up to 10 metric tons of silver in 1984, at its new Plata-Inca mine in the Yukon Territory.

Northwest Territories, Canada

Lupin gold mine, Echo Bay Mines Ltd., Port Radium, Great Bear Lake, gold and silver producer, 56 miles south of the Arctic Circle. Grade 0.06 ounce silver per metric ton. 8.5 ounces of gold to 1 ounce of silver. Ore processing will be increased to 1,450 tons a day for the second half of 1984.

Cash break-even costs for the second quarter of 1984 were U.S.$210 an ounce of gold. At mid-year, one half of a metric ton of gold, (the output of the second half), was sold on a futures basis for U.S.$462 an ounce and 0.43 of a ton, (out of 1985 output) at U.S.$426 an ounce.

Nanisivik Mines, Baffin Island, in the Eastern Arctic, produced about 32 metric tons of silver in 1982.

Terra Mines, Camsell river region, Great Bear Lake, produced about 27 metric tons of silver in 1982.

Giant Yellowknife recovered about half a metric ton of silver in 1983.

CANADA (excluding Ontario)

SILVER PRODUCTION OF SOME COMPANIES

(metric tons)

	1979	**1980**	**1981**	**1982**	**1983**
Brunswick Mining and Smelting Corp. Ltd.	96.3	94.6	94.0	98.8	113.4
Camchib Resources Inc.	0.9	1.4	0.9	0.9	0.7
Cominco	311.1	277.3	262.5	321.5	356.2
Consolidated Rambler Mines Ltd.	2.6	2.3	1.9	0.7	-
Cyprus Anvil Mining Corp.	45.0	68.1	53.5	28.6	-
Dankoe Mine Ltd. (NPL)	6.1	6.1	3.5	0.5	0.6
Dickenson Mines Ltd. (Silvana Division)	9.0	7.9	11.0	9.7	7.9
Echo Bay Mines Ltd.	62.0	41.8	34.9	3.6	-
Equity Silver Mines Ltd.	-	53.1	227.9	216.8	154.2
Hudson Bay Mining & Smelting Co. Ltd.	37.2	40.9	39.4	42.3	39.7
Noranda Mines Ltd.					
Babine Division	0.4	4.1	3.2	2.0	—
CCR Division	642.2	686.1	589.9	442.5	698.1
Lyons Lake Division	-	5.8	32.8	23.5	60.1
Similkameen Mining Co. Ltd.	4.3	4.9	4.5	5.4	5.7
Teck Corporation	42.4	34.5	34.3	34.6	25.8
United Keno Hill Mines Ltd.	77.2	51.8	36.0	37.3	19.8
Westmin Mines Ltd.	37.3	30.5	29.1	29.8	27.1

5.3.6 AUSTRALIA

Silver was discovered in New South Wales in 1876; gold in 1851. Captain James Cook discovered silver-rich Australia and New Caledonia and Hawaii in the 1768-79 period.

Australia ranked as the world's sixth largest mine producer of silver in 1983 with an estimated 1,050 metric tons. It was 743 tons in 1981 and 908 tons in 1982. 1983 is estimated at 1,050 metric tons and 1984 at 914 tons. Total mining industry sales for export were a A$9 billion, 40 per cent of the country's exports, with a net profit of A$461 million in 1983-84, compared to A$381 million in 1982-83.

Mount Isa Mines Ltd. (MIM) in Queensland produced 339 metric tons of silver in 1983 and normally provides almost half of Australia's silver output. The U.S.$340 million Hilton mine in Queensland, now being developed by M.I.M., grades 4.8 ounces of silver per ton. It is 12 miles north of Mount Isa, the world's largest silver-lead mine, plus some copper and zinc, and will supplement the Mount Isa output. Test mining planned for 1985 may be delayed due to the company's need to conserve capital.

East of Mount Isa, a 50 per cent interest in the Lady Loretta silver-lead-zinc project is held by MIM. Triako Australia Pty., a subsidiary of French Elf Aquitaine, is the other joint venturer (seeking another partner) and may sink a single shaft to exploit higher grades and provide cash flow.

Australia's newly mined output of silver since 1945 has grown more slowly than that of Canada and Peru. In 1984, Australia completely abolished its exchange controls, which might encourage more foreign investment in mines. By late October, 1984, the Australian dollar had fallen to 83 cents U.S.

In South Australia, the giant A$1.7 billion Olympic Dam copper-uranium-gold-silver project, (Western Mining 51 per cent/BP Minerals of British Petroleum 49 per cent), has been given a development clearance, but this will probably begin on a smaller scale than originally intended, concentrating on the higher grade gold areas. At full output, this copper-uranium-silver-gold operation could produce 23 metric tons of silver a year. The probable reserves contain an estimated 2,700 metric tons of silver, the grade being 4 to 6 g. per metric ton.

North Broken Hill Ltd. produces up to 85 metric tons of silver a year.

The Kidston gold-silver project in Queensland, which will be Australia's largest gold producer, running 0.079 ounce silver per metric ton, is being developed by Placer Development, Vancouver, British Columbia, Canada at a cost of U.S.$170 million. Output from 1985 will be 4.1 metric tons of silver and 8.5 to 9.3 tons of gold, (at a cost of U.S.$104 an ounce), a year during the first 5 years. 45 per cent of the shares must be sold to Australians by March, 1986. Placer of Canada held 70 per cent in 1984. It is 280 km. west of Townsville.

GOLD MINES PER SE ENJOY A TAX-FREE STATUS IN AUSTRALIA. However, the Australian Treasury is keen to bring gold into the tax net for the first time since the 1940's.

Other gold producers include Mount Charlotte and Fimiston mines of Kalgoorlie Mining Associates, North Kalgurli, Paringa, Telfer, Mount Magnet, Norseman, Meekatharra, plus the Occidental discovery north of Kalgoorlie grading 4 to 5 g. per ton to a depth of 200 feet, open pitting.

Western Mining (WMC)

Western Mining's main gold interests include

Central Norseman	50.5 per cent
Kalgoorlie Mining Associates	10.2 per cent

— all under Western's Management

The British firm, Selection Trust, has 4.45 per cent of Western Mining Corporation.

The ore reserves at the Paringa leases of Hampton Australia, (20 per cent), and CSR have been increased from 577,000 to 4.127 million tons. Start-up was in 1983, and during the year some 192,000 tons of ore yielding 217 kilograms of silver were processed.

MAIN MINE PRODUCERS OF SILVER IN AUSTRALIA

Mine/Company	State	1983 Output of Silver (metric tons)
Mount Isa, MIM Holdings, (Asarco, U.S.A. 44 per cent)	Queensland	339
Zinc Corporation, at Broken Hill, British-controlled CRA 100 per cent and	NSW	108
New Broken Hill Consolidated, at Broken Hill, British-controlled CRA 100 per cent	NSW	
Woodlawn Joint Venture, British-controlled CRA 33 per cent, with partners Phelps Dodge, U.S.A. and St. Joe Minerals, U.S.A.	NSW	12
Cobar Mines, British-controlled Conzinc Rio Tinto Australia (CRA) 100 per cent	NSW	6
North Mine, at Broken Hill, North Broken Hill Ltd.	NSW	71
Rosebery, EZ Industries Ltd.	Tasmania	49
Elura silver-lead-zinc mine, (output began 1983), near Cobar, NSW, EZ Industries Ltd. developing. Reserves grade 135 g. per ton silver	NSW	n.a. (one estimate is 141; another is 153)
Que River, Aberfoyle Ltd. 90 per cent. Shut since 1984. To be closed indefinitely if union problems not solved.	Tasmania	30
Blackwood, South mine, at Broken Hill, Minerals, Mining and Metallurgy Ltd.	NSW	20
Queenstown mine, Mount Lyell, (Renison Goldfields 100 per cent) Likely to be closed by end-1984.	Tasmania	2.7
Mount Lyell, gold silver producer	Tasmania	7.12
Warrego mine, Tennant Creek, gold producer, Peko Wallsend	Northern Territory	1
Teutonic Bore, British-controlled Seltrust (BP) 60 per cent, MIM 40 per cent	Western Australia	0.9 (1983)
Central Norseman, gold producer	Western Australia	0.7
Kalgoorlie Mining, gold producer	W.A.	n.a.
Telfer, gold producer	n.a.	n.a.
Kia Ora Gold, silver and gold, Marvel Loch	n.a.	n.a.
Kidston (Placer Mining of Vancouver, Canada 70 per cent)	Queensland	1985 start-up

MAIN MINE PRODUCERS OF SILVER IN AUSTRALIA (Continued)

Mine/Company	State	1983 Output of Silver
Minerals, Mining and Metallurgy, South Mine, silver, lead, etc.	n.a.	n.a.
Mount Carrington Mines, Lady Hampden	n.a.	n.a.

Refineries

The Electrolytic Refining and Smelting plant at Port Kembla, NSW, produced 47.86 metric tons of silver in 1983.

BHAS works at Port Pirie, South Australia produced 211 metric tons of silver in 1983.

Johnson Matthey Australia, Kogarah

5.3.7 Poland

The Kupferschiefer shales have been mined in what is now Poland since about 1150 A.D. They contain about 60 parts of silver per million.

Poland greatly increased its mine output of silver in the 10 years prior to the Solidarity events.

Poland is an important mine producer of silver, seventh largest in the world in 1983, arising mainly as a by-product of copper mining. The country produced about 655 metric tons of newly mined silver in 1982 and some 675 tons a year in 1983 and probably 687 tons in 1984. Much of this silver goes to the Soviet Union. Polish silver is extremely important to the U.S.S.R.

Poland probably produced 6,000 metric tons of silver in the 1957-82 period, an average of 240 tons a year.

The Solidarity troubles reduced Poland's output of silver.

Export of silver was only 270 metric tons in 1983, compared to 370 tons in 1982.

A possible silver output of 990 tons of silver a year by the late 1980's and 1,280 tons by the early 1990's at the Sieroszowice and Rudna mines is mooted.

Poland wants to boost silver output and silver exports, (which is, of course, also in the interest of the Soviet Union), as part of a U.S.$636 million copper mine-refinery expansion, by 1988. (So far, it does not appear to have raised the money. Poland owes the West U.S.$29 billion already.)

West German banks are major lenders to Poland and if Poland defaulted on its loans, could lose well over U.S.$5 Billion.

A total of about U.S.$100 billion is owed to the West by the Soviet bloc of countries.

POLAND — SILVER — MINE OUTPUT — ESTIMATED

(metric tons)

1980	1981	1982	1983	1984 est.
766	640	655	675	687

5.3.8 CHILE

Chile is very rich in minerals. Chile has over 25 per cent of the world's copper reserves, as presently known. Codelco, the state-owned copper company is the single largest copper producer in the world.

In 1967, the nationalization of Chile's mines began with the takeover of the Chilean operations of Anaconda and Kennecott of the U.S.A. Nowadays, the Chilean military government is trying to attract foreign investment back to develop mines there.

Chile is the world's eighth largest mine producer of silver, with an estimated 468 metric tons in 1983, a sizeable increase since 1978's 255 tons. 1984 may be 460 metric tons. 1971 output had been only 85 metric tons of silver. About 30 per cent is from gold and silver ores. Chile's exports of precious metals in 1983 were valued at U.S.$344 million.

Chile depends on Codelco for 46 per cent of its foreign exchange. Chile's average exchange rate against the U.S. dollar was 35 per cent lower in 1983 than in 1982.

Chile's large external debt has reached about U.S.$20 billion. This is one of the heaviest debts in Latin America, in per capita terms. The 1983 interest payments on this debt, U.S.$678 million, were equivalent to Codelco's payment of state taxes that year.

Unemployment in Chile was about 25 per cent in 1984. Chile's copper workers earn only one tenth of what U.S. copper workers earn.

Nevertheless, relative to most other Latin American countries, Chile is considered to be economically stable.

Codelco, Corporation del Cobre de Chile, is the State mining agency. Its giant Chuquicamata mine, the world's largest open pit, originally developed by Anaconda, produces about 135 tons of silver a year and output is being expanded by 18 per cent. The Codelco company has been authorized to spend U.S.$1.4 billion by 1986 to expand its mines. It also operates the large El Teniente, El Salvador and Andina mines. El Teniente, originally developed by Kennecott, is the world's largest underground copper mine, located in O'Higgins Province (named for the Irish "Liberator of the country" in 1818). Codelco's net profits over the last 8 years total U.S.$1.9 billion — all transferred to the government, making, with taxes, a total contribution to the state of $4.74 billion in eight years. 1983 profit was U.S.$221 million on $1.8 billion. In 1984, profit may be U.S.$140 million. Its investment budget is the equivalent of U.S.$ billion. Chile's Bank Debt Advisory Committee, chaired by Manufacturers Hanover Trust Co., a major New York bank, had agreed in February, 1984, to lend Chile U.S.$780 million to cover its 1984 financing needs.

Codelco received, early in 1984, a U.S.$268 million loan from the Inter-American Development Bank to contribute towards a U.S.$760 million program to improve mining efficiency. The World Bank gave Chile U.S.$30 million in 1975. Codelco plans to spend U.S.$400 million a year, 1985 through 1988 to raise production to 1.4 million tons.

In 1981, Chile produced 1.1 million metric tons of copper. In 1982, Chile actually increased its copper output by 15 per cent, while the U.S. cut its production by 25 per cent and Canada cut output by 11 per cent. In 1983, Chile produced 1.3 million metric tons of copper, (displacing the U.S.A. as the world's largest producer). Chile retains its 20 per cent share of the world copper market. By 1990, Codelco could be mining 1.55 million tons of copper a year.

Codelco's production of doré metal, (silver plus gold), totalled U.S.$59 million in 1983, compared to $43 million in 1982.

Enami, (Empresa Nacional de Mineria), another state-owned company, refines and sells ore from many small mines and is the second largest silver producer in Chile with about 100 metric tons a year. 1983 output was 96.98 metric tons of silver. It has a refinery producing silver, gold, etc. at Ventanas.

The large El Indio gold-silver mine of the St. Joe Minerals Corporation, U.S.A., (80 per cent), grades 122 g. silver per metric ton. When El Indio achieves full capacity output, it should produce 46 metric tons of silver a year. Output commenced in 1979. There was some interruption to production in 1984. El Indio is about 180 kilometres east of La Serena and 420 kilometres north of Santiago.

Discovery of four gold-silver veins at the nearby El Tambo deposit will provide feed to the El Indio mill.

Empresa Minera Mantos Blancos, Chile's largest privately owned copper operation had a yearly output of 27.5 metric tons of silver in 1983 and over 46 tons of silver in 1986.

The La Escondida deposit joint venture of Getty Mining and Minera Utah de Chile, discovered in 1981, would require a U.S.$1 billion investment. Minera Utah is a wholly owned subsidiary of Broken Hill Pty., (BHP), Australia. Getty Mining is an indirect wholly owned subsidiary of Texaco. Silver is reported present in the ore. Reserves are 545 million tons, grading 2.16 per cent copper.

Adjacent to the El Salvador mine's Potrerillos smelter, is the Silica mine which may yet produce silver. It grades 4 to 5 g. silver per metric ton.

Chile's copper output, (and therefore possibly its by-product *silver* output), could almost double in the next 10 years, from 1.2 million metric tons a year to 2.2 million metric tons, according to Cochilco, (Comision Chilena del Cobre), Chilean Copper Commission, a government agency overseeing both state-owned and private copper activities.

At the Toqui mine in southern Chile, the most southerly mine in the world, an underground program has been started to delineate the extent of a high grade vein near which, on the surface, high values of silver, gold, lead and zinc have been encountered.

Compania Minera Rio Chilex, (Rio Algom, Ontario, Canada), Noranda Exploraciones, (Noranda, Canada) and Compania Exploraciones Dona Ines, (Superior Oil with Falconbridge and McIntyre Mines of Canada), are currently engaged in exploration in Chile.

5.3.9 JAPAN

With 306 metric tons of silver in 1982 and about 307 tons in 1983, Japan ranks as the world's ninth largest mine producer.

Promising silver and gold mineralization is reported at Sapporo, Hokkaido island by a subsidiary of Nippon Mining, with grade of 1,600-4,200 g. silver and 43-120 g. gold per ton.

Silver is mined by Dowa, Furutobe, Mitsui, Shimokawa, Taio and Toyoha.

5.3.10 SOUTH AFRICA AND NAMIBIA

Silver production has greatly increased since 1979. With 343 metric tons of silver in 1981, 304 tons in 1982 and an estimated 283 tons in 1983, South Africa and Namibia still rank as the world's tenth largest mine producer of silver. Namibia itself produces about 110 metric tons of silver a year. 1978 output of the Republic was under 100 tons. There was the cutback at the old silver-bearing copper mines in the west of the republic. The low point since 1970 was in 1974. Gold output reached its all-time maximum of 1,000.4 tons in 1970.

In the last 100 years, South Africa has yielded tens of thousands of tons of gold and substantial quantities of silver. Most of the silver obtained in South Africa has been from the gold and platinum mines of the Transvaal and the Orange Free State. In South Africa, apparently, not much silver is found at the considerable depths at which most of the gold mines operate. (The South African gold mines are the deepest mines of any kind in the world. Some are about 12,000 feet deep.)

South Africa's gold mines produce "crude bullion" bars weighing 35 kilograms containing about 88 per cent gold, 10 per cent silver and 2 per cent base metals. (In the world generally, silver is frequently a co-product or by-product of gold). All of this crude bullion is sent to the Rand Refinery Limited near Johannesburg, which is an associate company of the Chamber of Mines operated on a non-profit basis on behalf of the mines and is the largest gold refinery in the world. The refined silver bars produced there are of 99.9 per cent purity; weight 37 kilos each.

About 25 per cent of South Africa's gold is sold in the form of 1-ounce and other denominations of Krugerrand gold coins.

South Africa has put into the world market more than U.S.$10 billion in Krugerrand gold bullion coins, based on the late 1984 value of gold.

The South African Mint is the official supplier of locally produced silver to the local market and a police permit is required every time silver is transported. Silver really is that precious in South Africa.

Silver producers include Black Mountain, Crown Mines, Bonanza Gold Mine, East Driefontein, East Rand, Rustenburg Platinum, Impala Platinum, Tsumeb, (Namibia), Ventersport, Witwaterstrand Nigel, Prieske Copper and Messina, Transvaal.

A new, (1979), source of silver has been the lead-zinc-silver belt in the Northwestern Cape. The lead-silver-zinc Black Mountain mine at Springbok, Cape Province, (Phelps Dodge 49 per cent; Consolidated Gold Fields 51 per cent, the manager), operated at full capacity in 1983 and the same is planned for 1984 and 1985. Eventual capacity will be 125 metric tons of silver a year. The deposits contain about 18,000 tons of silver. Black Mountain carries a heavy debt burden.

Silver output in South Africa since 1970 has increased to over double while the tonnage of gold declined considerably. From being about one-tenth of the annual output tonnage of gold, silver output is now at over one-third of the tonnage of gold.

Revenue from silver sales dropped in 1983 by 7.4 per cent compared to 1982.

MINE OUTPUT OF SILVER AND GOLD IN THE REPUBLIC OF SOUTH AFRICA

	Silver		Gold
Year	Metric tons	Silver Value (Rands)	Metric tons
1910	25	181,580	
1911	28	197,014	
1912	32	248,748	
1913	30	231,644	
1914	28	204,942	
1915	30	212,490	
1916	30	212,622	
1917	29	345,994	
1918	27	375,216	
1919	28	457,608	
1920	28	491,742	
1921	26	274,882	
1922	35	342,854	
1923	43	395,776	
1924	43	424,940	
1925	36	333,796	
1926	31	253,160	
1927	31	237,062	
1928	32	248,128	
1929	32	227,006	
1930	33	166,828	
1931	33	139,520	
1932	35	131,678	
1933	33	173,708	
1934	31	191,374	
1935	32	271,806	
1936	33	194,102	
1937	34	198,926	
1938	35	199,348	
1939	37	217,000	
1940	40	259,108	
1941	45	313,128	
1942	46	310,810	
1943	41	282,432	
1944	38	256,818	
1945	39	315,144	
1946	38	489,072	
1947	36	436,124	
1948	36	439,526	
1949	36	475,536	
1950	35	604,230	
1951	36	754,214	

MINE OUTPUT OF SILVER AND GOLD IN THE REPUBLIC OF SOUTH AFRICA (Continued)

	Silver		**Gold**
Year	Metric tons	Silver Value (Rands)	Metric tons
1952	37	728,796	
1953	37	735,226	
1954	38	756,526	
1955	46	958,074	
1956	50	1,054,066	
1957	55	1,163,186	
1958	56	1,135,762	
1959	63	1,325,562	
1960	69	1,471,882	
1961	71	1,576,355	
1962	79	1,952,200	
1963	85	2,511,941	
1964	91	2,720,349	
1965	97	2,902,564	
1966	97	2,936,887	
1967	95	3,536,449	
1968	104	5,239,165	
1969	104	4,392,365	
1970	110	4,566,873	1,000
1971	105	3,546,137	976
1972	102	4,114,099	910
1973	114	7,331,163	855
1974	84	8,207,660	759
1975	96	10,012,472	713
1976	88	10,617,725	713
1977	97	12,607,089	700
1978	97	14,695,091	705
1979	101	28,872,517	704
1980	222	81,693,148	672
1981	343*	n.a.	655
1982	304*	n.a.	664
1983 est.	283*	n.a.	680
1984 est.	n.a.	n.a.	684

* With Namibia

South African gold production (and related silver output) is expected to peak in 1987 and to decline throughout the 1990's. Total refined gold potentially recoverable from South Africa's mines is estimated at over 22,000 metric tons.

Cecil Rhodes delivered a speech at a banquet in London on September 5, 1914, which has often been quoted. His remarks included the following:

"I have made a great study of the mining question and have statistics, not only of Great Britain and Africa, but of the world, carefully compiled, relative to this proposition, so that I might not be in error. This investigation shows that mining has always offered greater inducements than any business in the world to make quick and great wealth. My investigation further shows farming is more risky than mining; that 29 per cent more people lose money and fail in the mercantile business than in mining, and that 41 per cent more lose money in the manufacturing business than in mining; and 17 per cent more men lose money in any other business than in mining. MINING IS THE BACKBONE OF WEALTH AND THE SPINAL COLUMN OF ALL CERTAINTY. I believe that investment in good mining stock is the *most profitable investment* and very much the safest; and is the safest because your security is the ore itself and the raw material of money (silver and gold) is the security of your money in a good mining proposition."

This speech is of real importance to all who contemplate making a mining or metal investment or even entering the metal mining industry.

The silver price is, of course, greatly affected by the gold price.

The long-term price of gold is expected to continue to rise in real (i.e. constant dollar) terms, say from 1987/88 up to 2007.

The silver-producing gold mines include:

Blyvooruitzicht Gold Mining
Buffelsfontein
Consolidated Murchison
Durban Roodepoort Deep
East Rand Pty.
Eastern Transvaal
Freddies Consolidated
Free State Geduld
Free State Saaiplas
Grootvlei
Harmony
Hartebeestfontein
Kinross
Leslie
Loraine
Marievale
President Brand
President Steyn
Randfontein
St. Helena
South Roodepoort
Stilfontein
Welkom
West Rand Consolidated
Western Deep Levels
Western Holdings

Others include:

Barberton, Bracken, City Deep, Consolidated Main Reef, Crown, Deelkraal, Doornfontein, East Daggafontein, East Driefontein, West Driefontein, Elandsrand, Elsburg, Kloof, Libanon, Unisel, Vaal Reefs, Venterspost, Vlakfontein, Western Areas, Winkelhaak and Witwatersrand Nigel.

The world's single largest gold-mining complex is being created in the Orange Free State by Anglo-American, by a merger of Free State Geduld, President Brand, President Steyn, Western Holdings and Jeanette. It has potential for tax savings and cash flow generation outside the scope of individual mines but within the reach of one producer. Combined gold output is about 116 metric tons of gold a year, plus some silver. All of the Orange Free State gold mines have exhausted their reserves of high grade ore and are growing increasingly dependent on the lower grades.

SILVER BULLETS

During the Boer War of 1899 to 1902, a British army officer, who was a mine technician, examined the bullet that had wounded him. He found that it contained more silver than lead. Boer prisoners would not reveal the mine source. One such rich silver mine was discovered again in 1968 where old bullets were found that contained more silver than lead, near the Hartbeestport-Johannesburg road.

South Africa's share of whole world mine output of gold (estimate) is expected to continue to drop, from 49.2 per cent of world production in 1983 to 48 per cent in 1984 and to 46 per cent in 1985, so, in general terms, the output of by-product silver will possibly show something like the same falling pattern. South Africa's share of Western world gold production declined from 66 per cent in 1982 to 62 per cent in 1983.

South Africa currently produces about 680 metric tons of gold a year, but this is expected to decline progressively during the next few years (and therefore the silver output associated with it must inexorably decline too).

Since 1981, South African gold output has actually risen slightly and it is expected that production will reach around 700 tons per year in the fairly short term. Thereafter, a steady, but perhaps not unduly steep decline may be expected over the following 10-15 years or sooner. Beyond that, the fall could become much more rapid as the medium- to long-life mines by today's reckoning reach exhaustion.

Future output could peak in 1989 at 720 metric tons a year and decline to 570 tons by 1999. A rapid drop to 400 tons by 2005 would follow, (unless some new mines from 1990 onwards were able to manage to raise the total to say 620-670 tons by 1999 and to 480-560 tons by 2005).

One half of the world's gold reserves (in ore) are in South Africa, much of it at great depth.

Recently, gold has been mined profitably in South Africa at an average cost of about U.S.$209 an ounce. 75 per cent of the mines with output costs below U.S.$209 per ounce produced almost 50 per cent of the country's gold. South African gold production is a vital contributor to that country's balance of payments. Since 1968, through tax relief or direct monetary assistance, $195 million has been provided to about 11 per cent of the mines. However, over the period since 1968, it is estimated that the taxes paid by the subsidized mines have exceeded the aid allocated, excluding interest etc.

EXTRACTION COSTS FOR ONE TROY OUNCE OF GOLD AT CERTAIN SOUTH AFRICAN GOLD MINES, WHICH INCLUDE THE COST OF EXTRACTING THE SILVER

(September, 1984)

East Rand P.M., Barlow Rand	U.S.$ 366
Durban Deep, Barlow Rand	332
West Rand Consolidated, Johannesburg Consolidated Investments	388 (July)
Loraine, Anglo-Transvaal	265
Western Areas, Johannesburg Consolidated Investments	267
Free State Geduld, Anglo-American	237
Harmony, Barlow Rand	242
Stilfontein, General Mining Union Corp.	270
Grootvlei, General Mining Union Corp.	193
Bracken, General Mining Union Corp.	219
Leslie, General Mining Union Corp.	199

(Excludes depreciation, royalties and taxes throughout).

Sources: Engineering and Mining Journal; Silver & Gold Report; converted from Rand currency.

The State Assistance Scheme under the Gold Mines Assistance Act for certain gold mines in South Africa, which was intoduced in April, 1968 has contributed to a negative effect on the world silver price by depressing the gold price to some extent, as follows:

> the small number of marginal producers using the scheme prolonged their mine lives and produced extra gold that acted to depress the world gold price. If those mines had closed down, a smaller total amount of gold (as well as silver) would have come to market and the gold price would have been higher, (and therefore, it may be reasoned, the silver price too).

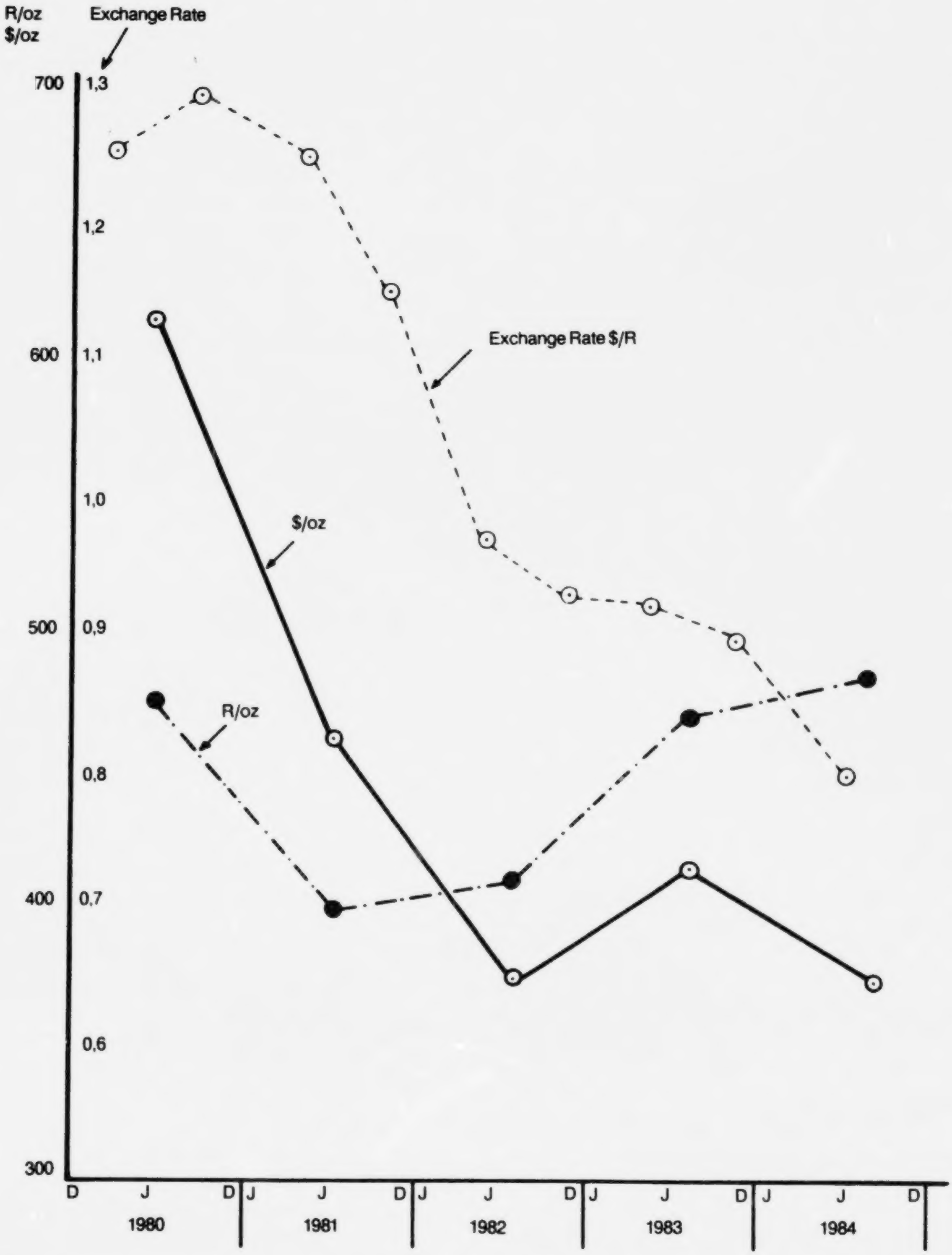


Figure 3. Annual average gold price expressed in $/oz and Rand/oz compared to the $ - Rand exchange rate since 1980

Source: "South African Uranium Resources and Production Potential", P.D. Toens & W.J. DeKlerk, NUCOR. AIR, September 30 — October 3, 1984.

Some South African mines still receiving State aid in 1984 were:

		Annual Output Capacity, est.
1.	East Rand P.M., Barlow Rand	11.7 tons of gold
2.	Durban Deep, Barlow Rand	7.2 tons of gold
3.	Loraine, Anglo Transvaal	5.3 tons of gold
4.	Leslie, General Mining Union Corp.	3.7 tons of gold
5.	Venterspost, Consolidated Gold Fields	5.9 tons of gold
6.	Wit. Nigel	1.0 ton of gold
7.	Marievale, General Mining Union Corp.	1.3 tons of gold

State Assistance to marginal producers of gold-silver such as Loraine, Venterspost, Durban Deep and Marievale will not, after all, be terminated in 1984, according to the Mineral and Energy Affairs Minister. It will be modified instead. Four mines were receiving aid under the amended scheme.

Evidently, South Africa badly needs every ounce of gold and silver it can produce.

However, in contrast, the government has increased the tax surcharge paid by all gold and diamond mining companies to 20 per cent, from 15 per cent, effective April 1, 1984. The general sales tax has also been raised to 10 per cent from 7.

The mining industry regards the tax regime as oppressive, taken as a whole.

During the past six years the number of civil servants in South Africa has risen by almost 22 per cent to 373,000.

The Free State Geduld mine has been adversely affected by the relatively low gold price in that it is getting close to the point where it will not generate enough profit to get the full benefit of its tax shield on its planned capital expenditure program. See large Anglo-American mine merger described earlier.

From the latter part of 1983, South Africa had begun to slide into a recession after giving the impression that it had achieved a turnaround. The steep rise in interest rates, which are at unprecendented highs, was strangling expansion. By the end of 1983, new inflationary pressures had emerged, holding stubbornly above 10 per cent, which have brought the tax increases and higher interest rates. By the end of October, 1984, it had accelerated to 12.5 per cent annually.

The 1980 Rand/Dollar parity was R1=U.S. $1.27. In January, 1981, the South African Rand was worth U.S.$1.34.

The South African Rand currency was worth 90 U.S. cents early in 1984, but had fallen in value to 65 U.S. cents by end-July, 1984 to 58 U.S. cents by October, 1984 and to 43 U.S. cents early in January, 1985.

Of course, this means that gold reached a new high in price in terms of South African Rands, R. 536 an ounce, in October, 1984 and gold mines have record profit levels, (in Rands).

South Africa again had to import grain in 1984 — about 5 million tons — because of another drought. This is abnormal.

No major recovery in investment — whether in mines or anything else — appears likely before the end of 1985.

The largest corporate gold producer, Anglo-American of South Africa, cut back on some planned capital expenditures in its gold mines because of the depressed gold market.

West Rand Consolidated ceased production in 1983. Blyvooruitzicht will halt output later in 1984, as well as Western Deep Levels.

An increased exodus of whites from the Republic of South Africa could start in not too many years from now.

Namibia, formerly (German) Southwest Africa, currently governed by the Republic of South Africa.

Namibia produced an estimated 110 metric tons of silver in 1983. Tsumeb Corporation recovers about 42 metric tons of silver a year from its copper-lead-zinc mines, at Kombat, Tsumeb and Otjihase. Matchless produces 28 tons of silver a year. Klein Aub Kopermaatskappy Beperk and the Rosh Pinah mine of Iscor also produce silver.

5.3.11 BOLIVIA

Bolivia, lying southeast of modern Peru, was formerly Upper Peru.

187 metric tons of silver in 1983 make Bolivia the world's eleventh largest mine producer. Output has declined from over 200 metric tons a year.

Many people consider the Potosi district, over 4,000 metres above sea level, which the Spaniards discovered in 1544, as having been the richest silver mining area in history — having produced at least 30,000 metric tons since 1544 and probably sizeable quantities in years before that. But see Idaho, U.S.A. See also Peru re Potosi.

In 1553, Charles V of Spain decreed that Potosi was an imperial city. By 1650, it was THE LARGEST CITY IN AMERICA, population 160,000 and one of the most important urban centres of the world. Potosi now has only 90,000 people. Renowned for its wealth from silver, its churches glistened with silver and gold and magnificent colonial architecture went up. Potosi is situated at the foot of the Cerro Rico (Rich Mountain) on a 14,000 foot high plateau on the eastern edge of the Andes, where the climate is harsh.

The mines were worked by enslaved Indians and important black slaves from Africa, (Descendants of the latter survive in a tropical area and speak the Indian Aymara tongue).

To this day, the February/March annual Festival incorporates a ritual in which a llama is sacrificed at the mines and its blood sprinkled at the entrance to evict evil spirits and assure that a rich silver vein will be found.

Bolivia's silver exports have been valued as follows:

1980	1981	1982	1983
(million U.S. dollars)			
118	71	37	58

The mines of the Patino, Hochschild and Aramayo groups, providing 60 per cent of the nation's mineral output, were nationalized in the 1952 Revolution. Further moves were taken in 1983 to increase the involvement of the state.

The State Mining Corporation, Comibol, (Corporacion Minera de Bolivia), the main silver mining company and the State Refinery have completed construction of a U.S.$200 million silver-lead refinery at Karachipampa, near Potosi, but start-up has again been delayed by a failure to secure operating capital, a shortage of concentrates and the strikes by the Central Bank and the Controller's Office. It is to be run by ENAF, a state agency. It was to have come on stream in July, 1984, but this has now been delayed indefinitely. Bolivia, in any case, can only supply 50 per cent of the refinery's capacity. Concentrates to be treated may include several thousand metric tons of silver-lead from Peru's Minpeco. The government had given Karachipampa U.S.$3.7 million to cover first half 1984 expenditures.

COMIBOL — SILVER OUTPUT

	1982	1983
(metric tons)	183	147

Asarco's mine at Quioma produces a small amount of silver.

Bolivia's external debt is U.S.$3.6 billion. The country is near bankruptcy. Price increases in April, 1984 were 110 to 460 per cent for bread, sugar, oil, rice and gasoline.

Inflation was running at 328 per cent at the close of 1983.

5.3.12 MOROCCO

Morocco was an important mine producer of silver, fifteenth largest in the world in 1983 with about 119 metric tons reported, a little higher than 1981 and 1982.

Companies that produce silver are Societe Miniere de Touissit and Societe des Mines de Bou Skour, as well as Societe Miniere du Djebel Aouam, Imiter, Oued el Heimer. Zellidja S.A. is developing a new silver mine near Zgounder.

5.3.13 ARGENTINA

76 metric tons of silver reported as produced in 1983 from the mines.

Cia. Minera Aguilar, (St. Joe, U.S.A. 99.9 per cent), produces some 53 tons, or about two-thirds of Argentina's silver.

Another silver producer is Yacimientos Mineros de Agua de Dionisis.

Argentina's external debt is the third largest in the world, (after Brazil and Mexico), a formidable U.S.$45 billion. Its rescheduled public-sector debt was U.S.$20.7 billion in December, 1984. Argentina's expensive attempt to take away the Falkland Islands from Britain worsened the already poor situation.

Argentina had an inflation rate of 600 per cent a year at the end of 1984, and an estimated 1,000 per cent by the end of this year. State overspending is the main cause.

Argentine gold is being smuggled into neighbouring Uruguay, destined for the U.S.A., thus avoiding strict Argentine currency and export controls.

5.3.14 CHINA

China is the world's seventeenth largest mine producer of silver. China has only a small mine production of silver, say 80 metric tons a year, but it is rising, perhaps giving 85 tons in 1984. It is mostly won from lead-zinc ores.

The Chinese government stock may amount to some 7,800 metric tons of silver. However, private hoards may be much larger.

By the end of the 1980's, it is estimated by some that China will probably need over 1,500 metric tons of silver a year, which would mean very large imports, unless they find much more silver and can develop new mines.

A silver mine is believed to exist in Henan Province.

In Zhejiang Province, a sizeable new gold-silver deposit has been reported. The large gold and silver deposit was discovered in China in 1982. According to a report by the Zhejiang Daily Province newspaper, the deposit is in the Lishui prefecture in the south of the eastern Chinese province of Zheijiang. The lode has a high iron content and was found in pre-Devonian metamorphoric rock.

The prospecting plan for silver for 1983 was overfulfilled. New discoveries of silver deposits were twice the planned targets.

5.3.15 DOMINICAN REPUBLIC

Up to 70 metric tons silver per annum, but only 39 tons in 1983. 65 tons of silver can come from the Pueblo Viejo mine of Rosario Dominicana, but the company's output in 1983 was lower. Silver and gold in doré form, 80 per cent silver, are produced from the oxide zone open pit, which may be exhausted within 5 years, but if a pilot plant is successful, the underlying sulphide orebody at the state-owned Rosario Dominicana's mine could be in production in 1988-89 and could have 15 to 16 years of life.

Pueblo Viejo produced 63 metric tons of silver in 1981, 69 tons in 1982. The 1983 silver was valued at U.S.$15 million. It has been government owned since 1979, but Amax provides management and technical services through Rosario Resources Corporation which is a wholly owned subsidiary of Amax Inc., U.S.A.

Pueblo Viejo is the main source of the country's foreign exchange.

A massive sulphide deposit discovered by Falconbridge of Canada indicates silver, copper, gold and zinc.

5.3.16 SWEDEN

Sweden is the world's 12th largest mine producer of silver. 171 metric tons of silver were mined in 1983 and 168 tons in 1982. Boliden Mineral AB at Garpenberg North, Renstrom and Stekenjokk, produces about 170 tons of silver a year. The Aitik mine is its largest.

5.3.17 SPAIN

Spain is the 13th largest mine producer of silver and produced about 185 metric tons of silver in 1983 and 118 tons in 1982.

Penarroya, (Sociedad Minera y Metalurgica de Penarroya-Espana S.A.), produces about two-thirds and Cominco (Canada) at Rubiales about one-third.

Rio Tinto Minera at Cerro Colorado/Alfredo and Cia. La Cruz also produce silver.

5.3.18 YUGOSLAVIA

Yugoslavia is the 14th largest miner of silver and produces about 124 metric tons of silver a year, mostly from the state owned BOR complex. The government was forced to put up its central reserves of gold bullion against loans from abroad in 1983.

Trepca yielded an estimated 112 metric tons of silver in 1983. The Majdanpek precious metal enterprise is prominent.

5.3.19 FINLAND

Outokumpu Oy, at Keretti, has produced as much as 45 metric tons of silver a year but this may not all be mined in Finland. Mine output is probably much less.

SILVER OUTPUT — FINLAND

1981	1982	1983
	(metric tons)	
37.8	37.0	27.0

5.3.20 NORWAY

Norway is a mine producer of silver and has some rich veins, but the total silver output figure is not clear.

5.3.21 GREECE

Greece is producing about 60 metric tons or more of silver a year. The ancient silver mining area of Lavrion (Laurium) has been reopened as a government enterprise. An annual output of 35 to 55 metric tons of gold-bearing silver is expected there.

5.3.22 BRAZIL

Brazil may have produced about 66 metric tons of silver in 1984, compared to 55 tons in 1983.

Imports of silver rose to 97 metric tons in 1983 from 45 tons in 1981.

Brazil's foreign debt amounts to over U.S.$95 billion, the largest in the world. It was forced to put up its central reserves of gold bullion against loans from abroad in 1983.

Inflation hovered around 220 per cent a year in 1983 and 1984, and could climb to 250 to 300 per cent in 1985.

Brazil is the world's fifth largest arms exporter. Total exports were a record U.S.$27 billion in 1984.

5.3.23 ZAIRE

Zaire's Gecamines, (Generale des Carrieres et des Mines), produced about 39 metric tons of silver in 1983 from copper concentrates.

Zaire's average exchange rate was 56 per cent lower in 1983 than in 1982.

5.3.24 ZAMBIA

Zambia produces over 28 metric tons of silver a year from the copper mines of Zambia Consolidated at Baluba, Luanshya and Kabwe.

The World Bank has approved a U.S.$75 million loan to help the state owned mining company with its U.S.$300 million modernization scheme. Another $70 million is expected from the European Development Bank and $3 million from the African Development Bank.

Zambia's average exchange rate against the U.S. dollar was 25 per cent lower in 1983 than in 1982.

5.3.25 PAPUA-NEW GUINEA

The Bougainville gold-silver-copper mining company, (CRA, British-controlled Conzinc Rio Tinto, Australia 53.58 per cent; PNG government 21.08 per cent), produced 48 metric tons of silver in 1983. Ore reserves were graded 1.5 g. silver per ton, but have now been revised to 0.46 g. silver per ton.

The NGG (New Guinea Goldfields) mine at Wau, PNG, produced 180 kilos of silver in the 1983/84 financial year.

5.3.26 SOUTH KOREA/NORTH KOREA

South Korea output was about 67 metric tons of newly mined silver in 1983.

North Korea mined about 30 metric tons of silver in 1982 although some observers talk of 50 tons a year.

5.3.27 PHILIPPINES

The country produced a total of 63 tons of silver in 1981 and 63.5 tons in 1982 as a by-product of copper and gold ores.

Marcopper, in which Placer Development, Vancouver, British Columbia, Canada has a 39.9 per cent interest, produced 5.5 metric tons of silver in 1983, one ton of gold and some copper.

Benguet Corporation produced 10.5 metric tons of silver in 1983. Other silver producers include Atlas, CDCP, Consolidated Mines, Hercules, Sabena, Samar and Western Minolco.

5.3.28 IRELAND

Ireland produced 24 metric tons of silver in 1980, 18.5 metric tons of silver in 1981 10.9 metric tons of silver in 1982, and 9.9 tons in 1983.

Northgate's Tynagh mine closed in 1980 and the Mogul of Ireland mine shut down in 1982. Mogul is to be acquired by Westfield Minerals, a member company of Canada's Northgate Group.

Most of Ireland's production of newly mined silver now comes from Tara Mines Ltd. work on the massive lead-zinc orebody at An Uiamh (Navan) north of Dublin.

5.3.29 HONDURAS

Honduras produced 78 metric tons of silver in 1983.

Rosario Resources Corporation, (Amax, U.S.A. 100 per cent), produced in 1981 about 53 metric tons of silver from its El Mochito silver-lead-zinc mine, Santa Barbara province.

Central American Mining Group S.A. also mine and mill silver.

5.3.30 FRANCE

France produced from its mines about 21 metric tons of silver in 1983. Societe Mines et Produits Chimiques de Salsigne produces a small amount of silver as well as Societe Miniere et Metallurgique de Penarroya. See Chapter 9.

5.3.31 ITALY

Produces about 74 metric tons of silver a year.

5.3.32 BURMA

Produces about 17 metric tons of silver a year.

5.3.33 WEST GERMANY

Produces about 36 metric tons of newly mined silver a year.

5.3.34 SAUDI ARABIA

At Al Masane, in Southern Saudi Arabia, approaching the North Yemen border, three main orebodies of copper, zinc, silver and gold are to be developed. A long term interest-free loan has been approved and granted by the government. Proven reserves range from 24.55 g. per ton to 71.55 g. per ton, for an average of about 44 g. per ton. Output may include some 20 metric tons of silver a year.

The Mahd Adh Dhahab silver-gold mine, 400 km. from Jeddah, is to be brought back into production in 1985-86.

5.4 THEFTS OF SILVER FROM MINES

The stealing of silver and gold in metal form, or in ore, from mines and smuggling them out has the grimly humorous slang name of "highgrading". Thefts of silver from mines in Ontario in 1983 alone amounted to about $1.5 million and gold about $3.6 million, according to the Ontario Provincial Police Gold Squad. The Gold Squad said that the stolen metal sells for about 50 to 60 per cent of the bullion market price. A piece of gold the size of a cigarette butt brings the thief about $200. These thefts are conservatively estimated to amount to 1 per cent of precious metals produced in Ontario.

These highgrading thefts are big business in Ontario and across Canada and this is also true of the U.S. and other countries that mine large quantities of precious metals.

The practice of highgrading raises mine production costs.

It is an illegal activity which robs people of employment, companies of profits and governments of taxes. In extreme cases, it can even lead to premature mine closures which can be disastrous for one-industry towns.

5.5 SECONDARY SILVER SUPPLIES FROM SCRAP AND OLD COINS

> "Thou also has tried us, like as silver is tried."
> —Psalms lxvi.8

An inability to understand the scrap silver market will ensure a total lack of comprehension of the silver market as a whole.

Between 25 and 40 per cent (depending on the year) of all of the silver consumed in industry and the arts in the Western World is obtained by recovery from scrap, silver-bearing waste solutions and old coins, and from dishoarding. It varies each year.

Scrap demand always rises before a general economic upturn and scrap demand rose in 1984. The reason is that large metal companies would rather buy scrap than take the costlier step of reopening or raising mine output until they are sure a recovery is on the way.

At a real or constant dollar price range of U.S.$15 to $20 an ounce, substantial secondary supplies of silver would again come onto the world market, according to a study done for the U.S. Department of Commerce National Technical Information Service by Economic Consulting Services Inc.

Vast quantities of silverware, jewellery and coins were dishoarded by the public in 1979 and 1980 creating a glut at refineries and oversupply in the markets. Industry pruned back purchases because of the high prices and looked increasingly for substitute metals.

Silver supplies from scrap and dishoarding have risen by 2 per cent since 1981.

During the last five years, the non-Communist world's secondary supplies of silver recovered from scrap and all other non-primary basic sources, excluding private bullion inventories, has ranged between 4,500 and 7,300 metric tons a year, an annual average of 5,500 metric tons. Currently, it stands at about 6,000 metric tons a year, according to Credit Suisse.

At a value of say U.S.$8 an ounce, 5,500 metric tons might now be worth around 1.8 billion dollars. Nearly two thirds of the silver sold in the U.S.A. in 1981 came from recycled silver.

There was a dramatic increase in the recovery of silver from scrap in 1980, 3,779 tons and in 1981, 3,266 tons because of the much higher silver price.

In 1983, about 2,084 metric tons of silver were recovered from scrap in the U.S. alone and constituted over 55 per cent of the total quantity of silver consumed in the U.S. in industry and coinage.

The smuggling of old pre-1949 Chinese silver coins out of China by daring skippers for delivery to Hong Kong has been going on for several years. They are exchanged for western products such as radios, tape recorders etc. which are contraband in China. The Chinese government therefore opened an agency in Hong Kong to recover some of its lost silver and in 1981 alone was reported to have gotten back more than 170 metric tons of silver in such coins. It is said that in 1980 alone, some 440 tons or U.S. $120 million of old silver coins were smuggled out of China. Private silver stocks there held secretly may greatly exceed the government stock estimated at about 7,800 metric tons of silver. To counter this flow the Chinese in Beijing have begun buying silver regularly from the Hong Kong markets and in the year June, 1980 to June, 1981 were reported to have bought about 170 tons (mainly old coins).

Problems related to Third World debt and various political/military crises are at present more likely to result in distress selling of silver and gold jewellery, tableware, etc. than panic purchases.

The runaway inflation in Argentina and Brazil has caused individuals to sell a large amount of gold and silver jewellery to the scrap market, i.e. effectively to the international market.

It appears that there are also considerable unreported stocks of silver bullion and coins in the U.S. which, under certain circumstances, could provide a telling extra supply of silver to the market. These unreported stocks have been estimated to total about 51,500 metric tons of silver at the close of 1980.

There are also an estimated 27,000 metric tons of silver in silverware in the hands of U.S. individuals, some of which would enter the market under attractively special price conditions. This did happen for a short period early in 1980.

SILVER — RECLAIMED FROM OLD SCRAP IN U.S.

	(metric tons)	**Percentage of U.S. Consumption**
Silver recovered, 1983	1,090	29
	843 (1982)	
	1,210 (1981)	

Source: U.S. Bureau of Mines.

Secondary recovery of refined silver from various forms of scrap in the U.S. has been as high as about 50 per cent of the total silver used; 40 per cent in the world as a whole. The other 50 per cent was newly mined silver. One could therefore argue that, in the U.S., out of 10 troy ounces of silver used, 5 ounces is from recovery from scrap, but in the near future, another 5 ounces would be recovered, then later on 2.5 ounces out of that first scrap recovery silver will be reclaimed and so on.

This continuous recovery of silver from scrap represents a huge new "mine" of silver which was simply not there to act as such a major factor when the silver price was low, i.e. about U.S. $1.29 an ounce, a few short years ago.

The total amount of silver recovered from new and old scrap in circulation even in 1963 amounted to almost three times the amount of silver from U.S. domestic mines, according to one writer, using U.S. Bureau of the Mint figures.

In the future, consumers will have only two serious sources of physical refined silver — the mines and the increasingly important secondary refiners, who will have been improving their recoveries. If and when prices go higher, the incentive to recover from scrapped old silver increases. Secondary refining of silver might double or triple in such a case.

Noble metals such as silver, gold, rhodium, iridium, platinum and palladium will become much more precious because of their rarity and will be the basis of a greatly expanded recovery-from-scrap refining industry. This situation in turn will be greatly intensified when social upheaval escalates in South Africa, particularly for platinum, gold, rhodium and iridium.

AN ESTIMATE OF WORLD SILVER SECONDARY SUPPLIES EXCLUDING COMMUNIST AREAS* 1977-81 (less flow to and return from private stocks)

(Metric Tons)

	1977	1988	1979	1980	1981
Secondary sources of supply					
U.S. government	12	3	3	3	65
Stocks of other governments	156	261	96	162	62
Demonetised coin	715	435	793	1,711	373
Indian exports & domestic use	1,263	1,415	1,042	1,390	1,042
Recoveries from scrap	2,930	3,001	2,504	3,779	3,266
Liquidation of (or addition to) private bullion stocks	821	1,428	1,085	(3,602)	(1,533)
Total	5,897	6,544	5,524	3,443	3,275

* Totals are rounded

Source: Handy & Harman, Samuel Montagu, EIU.

EIU estimate that in the years 1960-82 alone some 20,000 tons of coins worldwide were demonetised and that a further 38,000 tons were still in private stocks. A report for the U.S. Interior Department's Bureau of Mines suggested that in the U.S.A. alone unreported stocks of 49,700 tons of silver were held by private individuals in the form of bullion and coins. The report's authors were able to calculate back to 1933. Of this total some 61 per cent (30,300 tons) was held in the form of coins by the public and the remainder (19,400 tons) was held in the form of bullion by a more limited group of individuals including speculators. In addition to the stock of bullion and coins, U.S. individuals held roughly 26,400 tons of silver in the form of sterlingware.

ANOTHER ESTIMATE OF SECONDARY SILVER, Estimated (metric tons)

1. From old silver coins from India and from various sales by governments
   — excluding scrapped silver artifacts, industrial scrap and Soviet Bloc

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
India	498	995	591.0	1,213	2,306	2,053	2,177	1,263	1,415	1,042	1,390	1,042	1,309	1,456
Old Coins	778	622	467	1,213	1,462	1,089	1,711	715	435	793	1,711	373	404	249
Sales by Governments	2,417	233	383	1,645	367	656	258	168	264	100	165	128	345	460
TOTALS	3,692	1,851	1,440	4,071	3,135	3,798	4,146	2,146	2,115	1,935 (Annual Average 1970-79 2,830)	3,266	1,543	1,788	2,165 (Annual Average 1980-83 2,190)

2. From scrapped silver artifacts, industrial scrap etc.
   — excluding Soviet Bloc
   — excluding silver from old coins, India and government sales

From Old Scrap	1,095	880	1,409	1,879	2,044	2,277	2,678	2,930	3,002	2,504 (Annual Average 1970 through 1971, 2,068)	3,779	3,266	2,519	2,753 (Annual Average 1980 through 1983, 3,079)
TOTALS	4,787	2,731	2,849	5,950	5,179	6,075	6,824	5,076	5,117	4,439	7,045	4,809	4,308	4,918

When the silver price goes below U.S. $7 an ounce, supplies of scrap silver fall off dramatically.

When the silver price rises above U.S. $10 towards $20, supplies of scrap silver of all types to secondary silver refineries would increase considerably.

Above $20, supplies of silver scrap could increase sensationally.

Data do not add because of rounding.

Source: Silver and Gold Report; T.P. Mohide; Economic Consulting Services report for U.S. Department of Commerce; Samuel Montagu, merchant bank and bullion dealer.

5.6 MONIES FOR EXPLORATION – THIRD WORLD

Only about 15 percent of total mineral exploration expenditures are currently directed to Third World countries.

The U.S.A., Canada and Australia, (all English speaking and politically stable), plus South Africa, account for the bulk of such expenditure. A spokesman for Boart International said in late 1980 that the largest mineral exploration worldwide is in the U.S. and South Africa, closely followed by Canada and Australia, with some oil companies still funnelling large sums of money into the mining industry.

The concerns of the private sector have inhibited the undertaking of expensive mineral exploration in the Third World, where the growing politicization of the mining industry is a major factor.

The U.N., via its agencies, has made an exploration effort in Third World countries, but its total contribution, even with the counterpart funding by host countries, still only adds up to the average expenditure of one large mining company.

The Lome II Convention does not assign any priority to mining.

The recession in the U.S.A. etc., together with the fall in some metal prices, reflect in part some major readjustments in the world. The political-economic framework for the mineral sector has greatly changed and will change further. Options are becoming narrower.

The factors contributing to instability — political upheaval, with military attacks, e.g. on SASOL, South Africa, strikes, energy costs, technological change, substitution, declining demand (in some cases), excess mineral production capacity and the build-up of stocks of metals and minerals by producers, consumers and governments — will not go away, it seems.

The fundamental problem is the price level of the metals or minerals, not worry by consumers over long term security of supply. Metal and mineral prices will rise or fall to whatever levels are required to satisfy demand against the background of available supplies.

Chapter 6 Demand, Consumption and Uses of Silver

6.1 DEMAND, CONSUMPTION AND USES OF SILVER

> "The barge she sat in .... the oars were (made of) silver."
>
> -Shakespeare, "Antony and Cleopatra"

The wide range of uses of silver in industry, in electricity, electronics and the associated engineering, catalysis etc. sectors has developed largely in the present century and particularly since 1945.

SILVER — DEMAND IN THE WESTERN WORLD AND SUPPLY (estimated)

('000 metric tons)

	1978	**1979**	**1980**	**1981**	**1982**	**1983**	**1984 est.**	**1985 proj.**
Total Commercial Demand (Industrial and Coinage ex-including Soviet Bloc)	14.77	14.80 (16.00*)	11.75	11.26	11.75	11.73	12.40 to 12.70 (11.82 Shearson Lehman)	13.00 to 13.50
Total silver Supplies, including Newly Mined Output, Secondary Silver, Sales by Governments, Silver from India etc.	15.52	15.79	19.06	16.13	14.23	17.47	16.13 to 16.3	14.35 to 14.85

Sources: Metals Analysis and Outlook; T.P. Mohide; J. Aron/Goldman Sachs; Shearson Lehman/American Express, London.

* U.S. Bureau of Mines estimate.

n.b. 1) Total world consumption of silver is believed to have increased by about 1 per cent in 1983, according to the U.S. Bureau of Mines.

2) Total Supplies of Silver exceeded Total Commercial Demand in the period 1978 through 1984. The surplus supply of those years is in stock. This acts as an overhang to the market and is bearish for the price.

3) Free world annual demand for silver should rise to about 15,500 metric tons by the early 1990's, some observers say.

On the face of it, total free world demand for silver has greatly exceeded free world mine production of silver each year for at least the 30 years ending

1984. The consumption of silver in the last few years has surpassed newly mined production in each year by some 3,000 metric tons a year or so.

The eminent Swiss bank, Credit Suisse, estimated that world demand for silver would increase faster than total supply in 1984, but mine supply should be at record levels.

World silver consumption at mid-1984 shows continual gradual improvement, particularly in the U.S. There was a 15 percent rise there in the first half of 1984, compared to an unchanged 1983.

For the eighteen months through end-1985, many forecast moderate growth in the consumption of silver, but state that in 1986 it should improve markedly.

The most optimistic forecast for consumption is that it may increase by 2.5 per cent a year over the next few years or, at worst, it may continue at 1984 levels, according to Shearson Lehman/American Express, London.

Silver is not as dependent on the capital goods sector of the economy as the base metals such as nickel. Nevertheless, any improvement in capital goods sector growth would certainly lead to an increase in the consumption of silver.

However that is far from the whole picture.

All things considered, the industrial applications for silver have in the past been relatively limited.

Although the list of end-uses of silver both beyond and within traditional umbrella categories is now expanding, the major established end-uses are so far holding about steady regarding volume share of market, i.e. photography 35-40 per cent, electrical and electronic 25-30 per cent, sterling ware and silver plate 10-15 per cent, bearings 5 per cent and jewellery and coinage 5-15 per cent. However, estimating this split outside the U.S. is extremely difficult.

The leading Western World consumers of silver, after many years, still remain the same, i.e. the U.S., Japan, West Germany, Italy, the U.K. and France, in that order. Countries which are mine producers of silver, such as Mexico and Peru, marketed substantial mintings of silver coins in recent years. Such promotions help move the silver price upwards, according to most observers.

During the last twenty years, free world industrial consumption of silver has grown only very modestly. Compare the 1966 figure of about 11,200 metric tons with the 11,500 metric tons of 1982.

CRU's Silver study published in 1983, came to the conclusion that:

1) there will not be very much improvement in total world demand for silver in the future and

2) the price of silver, (in constant dollar, i.e. real money terms), will actually decline to something below the U.S.$10 to U.S.$15 level.

The problem for the observer and the analyst is that all of the information is not on the table, out in the open. Some things however are clear, i.e.

1) It appears that the formidable rise in the price of silver during the 1970's and early 1980's has acted as a severe constraint on the demand for silver. In industry, specifications have greatly reduced the amount of silver in many uses, probably permanently in a number of cases.

   Silver-consuming companies are managing their silver inventories more efficiently than ever in an attempt to stay hand-to-mouth, reflecting the high cost of money etc.

2) Recovery of silver from various forms of scrap has reached such a volume, (up to two thirds of an ounce obtained from scrap for every ounce mined currently), that this recycling is a greater factor in the market than has been generally realized, considerably diluting the price that would otherwise obtain. As the silver price rises for other and quite separate reasons, fresh scrap silver then arrives on the market at each price level and this acts to weaken the price to some extent.

   What is not on the table is hard data on such stocks of silver that become available to the consumption side at each rung of the silver price ladder.

   Newly mined production of silver in the western world has remained relatively stable, in a somewhat narrow range between 7,775 and 9,600 metric tons per year.

In the western world, the manufacture of chemicals, films and printing papers for the photographic industry accounts for about 40 per cent of the annual consumption of silver, (about 37 per cent in 1983). As an outside chance, this major market may be threatened over the next decade by the development of a silver-free photographic film. New photo-technology should not be a really major factor in the silver market for many years yet, however. X-ray films take about 20 per cent of overall total consumption.

On the positive side, silver is being employed elsewhere in increasing amounts such as in catalysts in certain water purification processes.

Total consumption of silver by the photographic industry of the U.S.A. alone could reach 3,000 metric tons a year by 1999. It was 2,000 tons in 1979.

The difference between free world consumption and newly mined production is, of course, made up by silver from the secondary or scrap markets and drawdowns from stocks in industry or government.

The consumption of silver is said by some observers to be sensitive to silver prices, a function of industrial demand, commercial demand and perceived supply. Prices rose from a moderate U.S.$5.05 per ounce in 1978 through an average of U.S.$11.05 in 1979 to a peak of U.S.$28.00 near the end of 1979, touching $45 in January, 1980. Silver prices then declined through an average of U.S.$20.30 in 1980 to a range of U.S.$6.50 — $7.00 early in 1982.

As prices rose, more secondary or scrap silver was recovered, i.e. scrap consumption increased by 55 per cent to 8,615 metric tons in 1980 compared with its previous 5-year average of 5,570 metric tons per year. At the same time, consumption of both primary and secondary silver dropped markedly. The phenomena of high price expectations and increased availability forced more than 7,150 metric tons of silver into private and commercial stock during 1980 and 1981. These extra stocks or inventories will eventually be fed back into the industrial and commercial markets.

Industrial demand for silver in the Western World should increase during 1984.

Any reduction in silver consumption by particular industries may be offset by increased demand for environmental and health uses.

Observers anticipate an upturn in U.S. industrial demand for silver in line with improving economic indicators. Data transmission provides the most important growth area for silver and the sales of commemorative silver coins remain high. 80 countries produced them in 1982.

HEDGING

Silver, which has been an inflation hedge of the relatively poor, will undoubtedly be used more and more for this purpose by the lower income groups as inflation continues to accelerate in many areas outside of the major countries. The fact that citizens in some countries are forbidden to buy gold bullion intensifies the upwards pressure on the price of silver and continues its monetary image as the only alternative to gold.

Some of the assets currently held in U.S. banking institutions will find their way into precious metals, because of nervousness over the serious problems facing many banks.

The use of credit cards has tripled investments in precious metals. According to Citibank, purchases of precious metals through the use of MasterCard and Visa credit during July, 1984 were three times those during June. The bank started accepting credit card purchases of gold and silver bullion over the phone in January, 1984. Citibank limits credit card customers to a minimum purchase of U.S.$1,000 and a maximum of $5,000.

It is equally important to point out that restrictive monetary policies in the U.S.A. have resulted in high interest rates which are more attractive to many speculative money holders than non-interest earning commodities, such as silver.

The Underground Economy, (or the Subterranean Economy) in the U.S. alone, i.e. earned income from a second (moonlighting) job or unrecorded exchanges or bartering of services or goods, or other monies not declared for taxation by tax evaders, drug dealers, cash skimmers etc. is now estimated at the enormous sum of U.S.$500 billion a year. Dr. F. Pick says U.S.$1.5 trillion in total size, including narcotics, gambling, pornography and bribery. The Underground Economy is thriving. Among the alleged causes of this illegal untaxed activity are the high tax rates on individual earnings, the complexity of U.S. tax laws and the perception, true or false, of great numbers of citizens that the U.S. government is operating a large machine that wastes taxpayers' money to some degree. Albert Einstein once said that the hardest thing in the world to understand is the U.S. income tax and many Canadians would say the same in their country.

Some observers say that the unofficial Underground Economy in Russia accounts for as much as 40 per cent of the USSR's GNP. Another estimate, by Andrei Sakharov, was the equivalent of about U.S.$65 billion for the year 1974. A Colombian government survey showed that 90 per cent of the country's silver, gold and platinum mining is illegally undertaken.

The Underground Economy is all around us. A man in Ontario thinks nothing of giving the hay from his 10 acres in the country to a local stables in return for their boarding his daughter's horse; tradesmen offer discounts if you pay in cash; "garage" and "flea" markets have multiplied etc.

Understandably, a great amount of this "underground" paper money, usually received as unrecorded cash, is used in part to buy "hard" money, such as silver coins, gold coins, silver and gold medallions, silver and gold bars and wafers, jewellery or objets d'art etc. This, of course, helps the miners of silver and gold in the silver and gold producing countries by adding to the demand for precious metals.

Further, the U.S. Census Bureau estimates that 4 to 6 million jobs are held by illegal immigrants in the U.S.A. who, they calculate, number 5 million to 7.5 million, mostly Mexicans, forming a large part of the Underground Economy labour in the U.S.

Demand for silver from China is expected by many to escalate dramatically in the next few years. The silver coins held there secretly by great numbers of individuals will not come onto the market, except for the normal trickle when the world price is high. See Chapter 8.5.1

Having considered the known variables, it appears that

1) world silver consumption should increase gradually;
2) excess silver inventories in industry should continue to be reduced and
3) near-normal supply/demand patterns should be resumed later in this decade or shortly thereafter.

Silver should show extremely favourable price increases compared to the base metals.

Silver demand overall will be impressive, with the non-communist world demand rising to about 15,500 metric tons a year by the early 1990's, say Charles River Associates, adding that total supply will be more than adequate to meet demand in the next 20 years.

6.1.1 WORLD CONSUMPTION OF SILVER

The international market for silver has much greater breadth and depth than the markets for most other metals. Before 1940, silver was used mainly for silverware and coins but from the 1940's, industry has consumed increasing amounts of silver.

The leading consumers of silver, after many years, still remain the same, i.e. the U.S., Japan, West Germany, Italy, the U.K. and France, in that order. Countries which are mine producers of silver, such as Mexico and Peru, have issued substantial mintings of silver coins, primarily for sale in hard currency countries.

Silver-consuming companies are managing their silver inventories better than ever in an attempt to stay hand-to-mouth, reflecting the high cost of money. New computer stock control systems make this more and more efficient. There may be a move in business away from a deflationary psychology to an inflationary psychology. Even so, there are sizeable stocks of silver metal still readily available to the market. World stocks have increased by over 22,000 metric tons during the last five years.

CONSUMPTION OF SILVER IN FABRICATION AND COINS – WESTERN WORLD

(metric tons)

Main Countries	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983 est.**
Industrial Demand and Coinage and Medallions							
U.S.A.	4,789	4,986	4,892	3,890	3,630	3,850	3,720
Western Europe	n.a.	n.a.	n.a.	3,830	3,700	3,770	3,420
Japan	1,966	2,015	2,137	1,830	1,860	1,960	2,200
West Germany	1,932	1,580	1,269	n.a.	871	1,045	n.a.
Italy	1,051	1,300	1,026	700	886	n.a.	n.a.
U.K.	1,002	902	824	638	575	622	n.a.
France	856	1,035	908	n.a.	n.a.	n.a.	n.a.
Canada	283	289	261	290	292	289	290
Other countries	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total Western World	14,650	14,774	14,800	11,750	11,260	11,748	11,728

(excluding net imports by Eastern Bloc countries)

Sources: Mining Annual Review; Handy & Harman; EIU; T.P. Mohide

Seven industrialized countries, U.S., Japan, West Germany, Italy, U.K., France and Canada account for some 85 per cent of Western world silver consumption.

Most countries have removed silver from their circulating coinage because of its value as a raw material but there has been a great increase in special issues which go to collectors.

Silver is an industrial metal used for a growing variety of products ranging from photography to electrical goods, sterlingware, jewellery and has an increasing market in commemorative and collection sets. In the longer term, a strong business climate and the growth in capital intensive and defence related spending will require a greater industrial use of silver.

Silver consumption by industrial sectors such as brazing alloys and solders, catalysts, electrical and electronic components picked up in 1981 to reach 4,420 tons after five years of continuous falls.

The silver producers must learn how to persuade the silver-consuming industry that silver is no longer a "scarce" commodity, but just another raw material with a relatively stable price future, but which has remarkable characteristics which are very useful to them.

Silver consumption in the first 9 months of 1984 was higher than previously expected and this is expected to continue in 1985, when demand could rise to 12,500-13,000 tons.

Total silver consumption is projected to rise from 12,906 metric tons in 1984 to about 17,400 tons in 1990, according to Metals & Minerals Research, London.

6.1.2 U.S.A. – CONSUMPTION OF SILVER

U.S. consumption of silver normally takes between about one third and 40 per cent of the total silver consumption of the non-Communist world, about 12,000 metric tons in 1983.

Today, U.S. silver consumption, about 3,720 metric tons in 1983, is almost the same as it was in 1971.

U.S. consumption of silver in jewellery was at its peak in 1975. The average price then was U.S.$4.42 an ounce.

U.S. consumption of silver for fabrication has narrowly exceeded the total for Western Europe for the 4-year period; 1980 through 1983.

More than 5,000 different items containing silver are used by the military, ranging from a naval torpedo taking 4,161 troy ounces of silver to a relay that uses only 23 grams; 150 different kinds of silver-containing bearings and a wide variety of silver-containing alloys of 19 to 96 per cent silver are used. The MX missile may perhaps require huge quantities of silver for back-up battery systems.

6.1.3 U.S.S.R. – CONSUMPTION OF SILVER

The Soviet Union's consumption of silver is very considerable. Not only has it not fallen, but it has growing demands in the photographic, electronic and armaments industries, perhaps totalling as much as 1,750 metric tons of silver a year. Some say 2,700 metric tons, but that appears high.

The U.S.S.R., in the early 1970's and before, used to sell some 250 metric tons of silver a year to the West, but that has greatly changed.

The Russians now consume not only their own newly mined silver and a little recovered from scrap, but also a high proportion of the mine output of silver of communist controlled countries such as Poland, (output say 640 tons) and North Korea, (output say 30 tons), a year, as well as silver purchased from the West.

At least 10 per cent of Soviet domestic consumption of silver has to be imported, it appears – probably more.

In 1918, the Soviets introduced paper tokens, sovznaki, in an attempt to get out of using the term "money". However, they decided in December 1921 to take steps to gradually move to a stable monetary unit. 1922 paper rouble notes were changed in 1923 at a rate of 100 1922 roubles (or 1 million of earlier issues) for one new 1923 paper rouble. In February 1924, a new paper rouble was introduced at a rate of 15,000 1923 roubles to one new paper rouble.

In 1932, the Soviets instituted a campaign to gather in all silver held by the people in the shape of coins, ornaments etc., for which owners were paid in paper roubles.

In 1934, Russia shipped 3.11 metric tons of silver to the U.S. to buy dollars with which to pay for imports from the U.S.A. It was not fine silver, but silver alloy and the value was undetermined when the report was made. Russia did not have any large stocks of silver then, it was reported.

Even their own modern Soviet publications, such as Material 'No-Tekhnicheskoye Snabzheniye (Material-Technical Supply), Moscow, September, 1982, Page 58, refer to the following:

1) a shortage of silver;
2) increasing Soviet domestic industrial demand for silver;
3) Soviet consumption of silver in jewellery has decreased, no doubt with strong "encouragement" from the State, which is perfectly understandable:
4) silver's lost significance in Soviet currency. This probably also means that supplies of secondary silver recovered from old coins etc. have shrunk, probably to virtually nothing.

What the Soviets would give for more silver!

With as many as seven so-called liberation wars going on in the Soviet Empire, Nicaragua, Ethiopia, Angola, Mozambique, Kampuchea, Laos and the five year war in Afghanistan, large quantities of Soviet armaments are indicated, requiring the appropriate quantities of silver, as well as related gold and platinum group metals.

Clearly, even the helpful imports of silver into the U.S.S.R. from Poland, (reduced in recent years owing to the Solidarity troubles and their effect on mine output), have not been enough to satisfy Soviet demand for silver. Normally, Poland mines about 650 metric tons of silver a year, but in the Solidarity years it may have fallen to 450 tons.

The Soviet Union was a net buyer of silver in 1981 and is reported to have purchased from the West late in 1982 as much as 310 metric tons of silver, when silver was rising to over U.S.$10 an ounce.

Soviet net import reliance regarding silver is estimated by observers to have represented at least 10 per cent of total Soviet consumption in 1982 and 1983, compared to only 3 per cent in 1981.

Recent Soviet imports of silver from the West alone may have been as follows:

1980	1981	1982	1983
(metric tons)			
31	217	653	600

Source: J. Aron; U.S. Bureau of Mines; T.P. Mohide.

Soviet purchases of silver are mainly made through the Soviet Wozchod ("rising sun") Trade Bank, Zurich, (owned by the Soviet Union's Foreign Trade Bank and the State Bank), the 16th largest foreign bank in Switzerland, or the Soviet-controlled Moscow Narodny Bank in London. Wozchod's chief bullion trader, a Swiss, was dismissed in the fall of 1984, following a preliminary internal audit. Some Sfr. 29 million was released from reserves to cover losses in trading gold in 1983.

Although it is estimated that there were no net imports of East Bloc silver by the West in either 1982 or 1983, it is now forecast by some that net imports of silver into the West in 1984 could be 150 tons, possibly Polish silver.

The Soviet government's stockpile of silver may be only about 2,200 metric tons.

Increased emphasis on the secondary recovery of silver from scrap such as photographic and X-ray film ash is their only domestic alternative, assuming that all "new scrap" in factories etc. is systematically recovered. One such secondary plant in Moscow is known. What happens in other major silver scrap source areas such as Leningrad, Kaliningrad etc. is not as clear. Such ash presumably contains about 0.2 g. silver per kilo of ash. One cannot easily picture the Soviet population as having too much solid sterling tableware etc. to turn in as scrap when the silver price is high in the West, compared to the U.S.A. in the 1980 run-up. Further, there is a shortage of (silver-bearing) X-ray film in the Soviet Union, as well as of surgical instruments and even aspirin.

There seems little doubt that sizeable numbers of silver coins are smuggled into the Soviet Union, effectively to be saved or hoarded as real or "hard" money, (as opposed to paper roubles), and not circulated in any sense except as part of the Underground Economy that is very large in the Soviet Union, perhaps as much as 40 per cent of the USSR's GNP. Nobel prize winner A. Sakharov estimated it ten years ago as at least 10 per cent of the Soviet economy, say 50 billion roubles, or U.S.$65 billion in those days. Inevitably, the KGB occasionally uncovers parts of the large underground money operations in the Soviet Union.

Almost anything can be "arranged" (called "nalevo,") because it is a vital activity, although illegal and makes the Soviet system work. The Soviet press puts the searchlight on corruption, thieving and illegal profiteering and money dealing, but never reveals its amplitude or any real detail. "Blat" is influence, connections, pulling strings to get what you want. Blat is essential in the Soviet system — constant, pervasive and absolutely vital. It is largely mutual backscratching to get around the "system".

6.1.4 CANADA — CONSUMPTION OF SILVER

Silversmiths were working in Quebec in Canada soon after the French conquest and settlement which began in earnest when Canada/Quebec was restored to the French in 1633 by the British, who had held it since 1629. Britain took Quebec permanently 130 years later in 1759. The U.S. revolutionists invaded Quebec in 1776, but were repulsed by Sir Guy Carleton, born in Ireland in 1724, the de facto "Father of British Canada".

Canada now consumes more silver per person than Great Britain.

Canadian silver consumption for all end-uses in 1983 is estimated to have been a little higher than the 1982 total of 289 metric tons of silver. 292 tons were consumed in 1981.

Canada's main export market for silver is the U.S., 74 per cent in 1982, but sizeable quantities go to Japan and Western Europe.

Virtually all of Canada's exports of refined silver go to the U.S.A.

Canadian imports of refined silver for the first two-thirds of 1983 were officially running at an annual rate of 367.68 kilograms, a relatively small amount.

6.1.5 JAPAN – CONSUMPTION OF SILVER

Demand for silver for fabrication and other uses has risen noticeably in Japan in recent years. About 1,100 tons of silver is used to make photosensitive materials in Japan each year. X-ray film use has grown particularly.

Important is a traditional taste or liking the Japanese have developed for silver since the feudal Edo period. There is a deep-seated appreciation among Japanese of the sombre white silvery colour. This characteristic also accounts for the Japanese liking for platinum jewellery. In the early 20th century, wearing gold became a question of bad taste in Japan.

As opposed to that, Shearson Lehman/American Express, London, say that silver has already become regarded as a "cheap" metal in Japan, with little attraction as jewellery.

6.2 USES OF SILVER AND ITS ALLOYS

Silver is for decoration, for adorning beautiful women, for providing wealth, for photographs, for healing, for industry and for religious and other gifts.

Silver's range of utilization is still increasing which is a source of great satisfaction to both mining companies and consumers. Industrial and chemical uses of silver are on the rise.

Silver has astonishing utilitarian qualities.

Modern Industry cannot do without silver.

Principal Western World uses in 1983/84 were:

1) Photography	40 per cent
2) Electronics, Electrical Components	19-26 per cent
3) Sterling tableware jewellery, ornaments	15-19 per cent
4) Catalytic converters	8 per cent
5) Medical	6 per cent
6) Miscellaneous	4 per cent

Pure silver is somewhat harder than gold, but softer than copper. Silver is normally sold as .999 minimum purity, (commercial grade) in bars of 0.031 metric ton approximate weight. Certain commercial qualities of gold are softer than silver under all conditions.

MELTING POINT OF SILVER

The melting point of silver is 1,762 degrees F.

This is very important because the first International Temperature Scale adopted in 1927 was based in part on the accepted melting point of silver at that time of 960.5 degrees C. This melting point is referred to as the silver point.

It is one of the six fundamental and fixed temperature points on that Scale.

THE UNIQUENESS OF SILVER

Silver has no competitors in 90 per cent of its uses, other than a few of the other precious (noble) metals which, of course, are all much more expensive than silver and therefore rarely competitive.

Silver is quite unique. If only it were not so scarce, we would use more of it. Most uses of silver will continue because of its unique properties, electrical and thermal conductivity, its photo-sensitivity, its optical qualities, ductility, its immunity to oxygen corrosion, its resistance to electrical "sparking", its ability to endure extreme ranges of temperatures etc.

Further, some of the unique characteristics of silver are going to be more fully exploited, for example, as a bactericide in preventive medicine and in other innovations in treatment. Silver will activate oxygen to kill bacteria.

In the old days, silver was so cheap that we used solid alloys. Now silver clad and silver plated cheaper metals are taking over more and more.

Silver's light sensitivity is superior to any other known material, for photographic films.

Silver is by far the best conductor of heat and electricity of all the metals — performing even better than copper.

Silver's thermal conductivity is 33 per cent greater than copper's and its electrical conductivity 8 per cent greater, when rated volumetrically. The volumetric conductivity of gold is only 66 per cent of that of silver.

Resistivity. The electrical resistivity of annealed silver is the lowest for any metal. Conductance figures are usually stated in terms of resistivity rather than conductivity.

Silver has a relatively high resistance to atmospheric oxidation. (Tarnishing is caused by sulphur compounds in the air, not oxygen.)

Silver has the whitest colour of all metals with a white lustrous sheen.

Silver has a perfect metallic lustre and is capable of a high degree of polish.

Silver is the best and most uniform reflector of light. It has the best reflectivity of any metal. Even the thinnest sheet reflects 95 per cent of the light striking it. The optical properties of silver are distinctive because of its exceptionally high reflectivity and very low emissivity.

The best mirrors are backed by silver. Aluminum and expensive rhodium have been tried as substitutes but with less efficiency.

Silver helps to concentrate the sun's rays on solar collectors.

Silver in extremely fine layers protects the heat-reflecting gold films in office window glass.

Silver is the most malleable and ductile of all metals except gold.

One gram (g) of pure silver can be drawn out into wire 120 metres long.

Silver can be beaten into leaves of a thickness of 0.00025 mm. or about 150 times thinner than this page.

Hammering or rolling hardens silver. Malleability is restored by annealing, i.e. slow heating at a dull red heat, followed by slow cooling.

Silver possesses great chemical stability.

Silver is sonorous and is used to make exceptional musical instruments.

6.2.1 NEW USES OF SILVER AND ITS ALLOYS AND SALTS

The most generous and special contributions of the Silver Institute in Washington, D.C. and its Executive Director, Richard L. Davies and his staff to the rest of the section on end-uses of silver are most gratefully acknowledged.

An expanding list of new end-uses for silver shows no sign of slowing down in electronics, in catalytic, medical and decorative uses, photographic and analogous uses, solar heating and in armaments.

New high technology applications include:

1) Thin transparent layers of silver/titanium oxide to remove ice and frost from electrically heated windows in aircraft and automobiles.

2) High pressure forming of hard and brittle materials (e.g. titanium boride).

3) Catalysts for a variety of oxidation reactions. In increasing amounts as a catalyst in some water purification processes, for example.

4) Silver-bearing yttrium to convert toxic carbon monoxide in the air to harmless carbon dioxide.

5) Silver-coated mesh to convert ozone entering jet aircraft from the upper atmosphere into harmless oxygen.

6) Mirrors for solar heating units.

7) Silicon-silver cells for solar heating, i.e. converting sunlight to electrical power. Silicon solar cells are criss-crossed by silver wire.

   Silver cells for solar breeders.

   Solar "breeder" panels, with direct sunlight-to-electricity conversion of up to 200 kilowatts per installation.

8) Silver halide treated sound tracks.

9) The medical regrowth of bone structures.

10) Bandages made with silver salts impregnated in carbon fibres provide durable anti-bacterial protection for common and severe wounds.

11) The coating of high pressure moving parts. Tests and experience with silver solid-film lubricated ball bearings, moving in bare or coated racings, show how silver acts as a superior dry lubricant.

12) Increased consumption of silver in both commercial and military batteries. Constant voltage batteries. Silver-hydrogen batteries. Silver oxide batteries power hearing aids and calculators.

13) New types in a new generation of silver-containing batteries for aerospace and perhaps other application.

14) Silver plating of fibres for electrical resistance

heating, electromagnetic screening and radar reflection.

15) For volume use in graphic arts, new imaging material made with silver chloride and silver stearate.

16) High energy thermally activated batteries made with silver nitrate and lithium salts, U.S. Navy.

17) Lower cost, higher efficiency solar cells built around webs of silver fibres, West Germany.

18) Improved formaldehyde production catalyzed by silver crystals on screens of silver-gold alloy.

19) Versatile multi-layer silver-containing wound dressing, University of Strathclyde, Scotland.

20) Electroconductive adhesives made with silver flake for bonding electronic parts, Japan.

21) Study of aluminum-silver cast alloys for aircraft.

"With the widespread use of silver throughout industry, one might assume that the silver researchers would have no more worlds to conquer — but this is not true," reported Richard L. Davies, Executive Director of The Silver Institute during his presentation of a paper on "New Developments in Uses of Silver" to persons attending the Fourth International Precious Metals Conference in Toronto, Canada.

He noted that, from many countries, new technical papers and patents on silver and silver products were then being produced at the rate of more than ten a day — more than 5,000 for example in the previous year and a half.

The demand for silver is bound to increase as these industries grow.

6.2.2 PHOTOGRAPHY

Silver chloride and silver bromide are light-sensitive compounds used in photography.

Extremely pure silver, 99.975 per cent pure, is used to make them for photographic film which contain the crystalline silver salts that instantly detect light falling on them and permanently record it. Light disturbs the structure of the compound and renders it selectively reducible to metallic silver by certain special chemical reducing agents known as "developers".

In photography, silver chloride in new tabular grain form provides faster development of high contrast images for instant photographs.

Photographs are produced by crystalline silver salts (halides). One gram (g) of silver contains enough power to make 200 colour pictures. 5,000 colour photographs can be taken with one ounce of silver. If the price of silver rises by U.S.$1.00 an ounce, the extra cost per picture is only one-fiftieth of a cent.

Silver halides provide greater light sensitivity than any known chemical. A TINY SILVER SALT CRYSTAL COULD DETECT THE LIGHT FALLING ONTO THE EARTH FROM A CANDLE ON THE MOON, if the moon reflected no sunlight on its own.

4 PHOTONS OF LIGHT CAN BE DETECTED BY SILVER AND IT CAN AMPLIFY THAT INCIDENT LIGHT BY A FACTOR OF ONE BILLION TIMES. ONE PHOTON OF LIGHT STRIKING ONE MOLECULE OF THE SILVER COMPOUND COATING ON A FILM CAUSES A DARKENING OF ONE BILLION NEIGHBOURING MOLECULES.

No other element does as well in this unique function of silver. Platinum is close, but, of course, it is 45 times more expensive. It is this effect *that nothing else can imitate* (and certainly not at that price) that causes scientists in physics and chemistry to think that replacing silver in photography is improbable.

There are no satisfactory alternatives for silver in the photographic processes and that situation continues to exist despite extensive research in the area of the development of substitute materials which would produce an image comparable to a silver-glazed system.

Silver's imaging capacity has never been equalled by any other means — electronic or otherwise — and probably won't in our lifetimes. Silver can "do it all."

Furthermore, photographic film can store far more information per unit area than magnetic tape, because silver halide crystals can resolve about twice as well as the best computer system.

As a general rule, the amount of silver in many manufactured objects or materials is only a very small proportion of the total product cost. The value of the silver content will therefore not affect the cost of the total product in those cases.

One can therefore confidently assume that the large photographic film manufacturers will utilize about the same amount of silver for this colour film, whether the price of primary silver is $5, $50 or $100 an ounce. The total amount of colour film used in the world is going to multiply considerably, in any case.

Giant by-product industries have sprung up from this basic use of silver — cinematography, metallography, radiography, microphotography, spectrography etc.

The overall world use of silver in photography will grow at an average of about 4 per cent per year.

So far, there are no substitutes for silver in photography, certain defence equipment etc. Any switching to methods such as electronic imaging, used increasingly in industry, will be an enormously expensive investment.

Demand for silver in the photographic industry is distributed between the medical, graphical and consumer-oriented sectors. It declined from 4,710 metric tons in 1979 to 3, 748 tons in 1981.

The photographic use of silver world-wide remains high and will rise with the increase in popularity of amateur photography and the tremendous future growth of the industrial business sector, X-rays etc. Consumer photography should remain the prerogative of silver-based film to 1990 at the very least.

Eastman Kodak consumes about 1,250 metric tons of silver and purchases about 1,550 metric tons of silver a year world-wide in a normal year (about 1,100 tons in the U.S. alone), for photographic film etc. It can recover about 450 to 620 tons from film and scrap in in-plant recovery. If the price of silver were to go back up to U.S.$50 an ounce which it touched briefly in 1980 and stay there, Eastman Kodak would appear to have to pay an extra U.S.$1.2 billion or so a year for its silver requirements.

The number two company in the world, Agfa Gevaert, uses around 700 tons of silver a year. Other major U.S. manufacturers together buy around 950 tons: Polaroid 70 tons, Du Pont 550 tons for X-ray films, MMM and GAF. Fuji and Konishiroku, the two biggest companies in Japan, use about 1,100 tons.

In the western world, the manufacture of chemicals, films and printing papers for the photographic industry accounts for about 40 percent of the annual consumption of silver. As an outside chance only, this major market may be threatened over the next decade by development of a silver-free photographic film. Eastman Kodak have said that their silver requirements are likely to rise in the years ahead as a result of increased film demand.

Ordinary Kodak "Ektachrome" colour film can have its nominal speed of ASA 400 increased to ASA 20,000 by a multiple development process discovered by The Academy of Applied Science, Concord, NH. This new development process multiplies silver's unique sensitivity to light to achieve high quality photographs that have been taken underwater, or from the air, in near darkness.

The 1949 invention of instant photography by Dr. Edwin Land made it possible for the photographic image to be available for the record, for diagnosis, or for communication in "real time". This development has caused photography to move subtly away from solely a medium of remembrance, to one that is increasingly used to convey and communicate information promptly. Now a development by Image Resources Corporation in California, the Videoprinter, uses the Polaroid process to provide instant colour prints, ranging in size from 35mm on up to 8" × 10", of the most sophisticated of computer colour graphics, thus uniting the silver halide systems to the ever-expanding computer industry. The implications of this process are staggering. Industry forecasts put the number of colour images generated by computer graphics systems by 1986 at over 100 million.

The reasons for preferring silver imaging of computer graphics are simple: electronic playback systems are hard to carry around to all potential users; not all computer storage information can be played on different systems and premium quality of reproduction requires substantial investments in equipment. Perhaps the most compelling reason of all for desiring a paper hard copy is the very deep-seated psychological need to own the information, as well as the strong desire to personalize it.

Of all the exciting developments in the application of "real time" photography — from industrial to medical observations — the one that may have the greatest impact is one that will occur in the home. It is estimated that within the next decade some 8 million homes will have personal computers which will be used for in-home use and for connection to outside information and other consumer oriented systems. There will be a desire for the user of the home computer to have the ability to record the results of his personal efforts, or the information that he has purchased from outside sources. Polaroid and others are seeking to develop an inexpensive system to satisfy that burgeoning need.

All of these developments depend upon the remarkable imaging capacity of silver halide. Any possible replacement of silver halide by electronic images in the future will be compensated for by the many new scientific, industrial, business and home consumer applications of silver halide prints that are now emerging..

New cameras provide grainless brilliance and clarity using 80 mm. size film which use 5 times as much silver halide per photo as 35 mm. films. One new camera has silver-plated electrical contacts and a 6-volt silver oxide battery.

Eastman Kodak have spent millions of dollars in research looking, unsuccessfully, for something cheaper than silver that will perform as well.

6.2.2 COINS OF SILVER

Modern Silver Coins

"A Chieftain to the Highlands bound
Cries 'Boatman, do not tarry
And I'll give thee a silver pound
To row us o'er the ferry."
-"Lord Ullin's Daughter," T. Campbell, 1777-1844

"And ye shall walk in silk attire,
And siller (silver) ha'e to spare."
-"The Siller Crown,"
Susanna Blamire, 1747-94

Silver in coin fabrication has been declining steadily: from 3,235 metric tons in 1960 to 728 tons in 1977 with an historic low of 187 tons in 1981. As a consequence, silver usage in this sector declined from 6 per cent of the total in 1977 to 3 per cent in 1981. Over the years 1960-82, consumers purchased an estimated 58,000 tons of new silver coins and returned 20,000 tons to be remelted — leaving a stock of 38,000 tons still in the hands of individuals.

New silver-containing coins made up a large proportion of the gains in world consumption of silver during the 1960's. However, in the 1970's and 1980's, far less silver per year has gone to coinage than in the prior period.

However, official silver coins issued by governments are not being discontinued, except that they are now not for circulation but are for private collectors. By 1982, they were using up 10 metric tons of silver a week, compared to only 2.20 tons a year before.

77 of the world's monetary authorities issued silver money, 264 silver coinage issues, in 1983. The world used an estimated 309 metric tons of silver in 1983 in making silver coins and medallions. This is an increase over the 288 tons used for coins in 1982 and 68 per cent more than the 183 tons in 1983, according to the Silver Institute. France issued 500 million silver francs, Austria 1.25 billion schillings, Sweden 60 million Kroner and Venezuela 30 million bolivares in 1983. In 1982, about 80 nations issued numismatic or commemorative legal tender silver coins. In 1970, only 34 countries issued legal tender silver coins. "Modern Silver Coinage, 1983" published in 1984, provides complete information on all silver money issued in the calendar year 1983.

The silver coinages include brilliant commemorations of outstanding events and personages, each fully described in the book. Also provided is complete information on the diameter, weight, per cent pure silver, troy ounces of silver per coin, number of coins issued, number as Proof, amount of silver used and total face value for all silver issues by all countries of the world.

For the convenience of those wishing to acquire the coins, the book gives the names and addresses of the mints throughout the world which struck each silver coinage issue.

The book is available at US$7, including postage, from:

The Silver Institute
1001 Connecuticut Avenue, N.W.
Washington, D.C. U.S.A. 20036

The highest percentage growth rate in silver use in 1984 will probably be in the coinage sector.

Buyers of legal tender silver coins receive benefits, including intangible benefits derived from ownership of a beautiful object and the very tangible benefit of a coin having

1) a face value,
2) a numismatic value and
3) the value of its silver content.

Special events such as the Summer Olympic Games in Los Angeles in 1984, give rise to an increase in this use of silver.

The U.S. government's silver stock (not the national security stockpile), has been drawn upon for the millions of copies of the U.S. Los Angeles Summer 1984 Olympic Games dollar and the 10 million silver half-dollars for the 250th anniversary of the birthday of George Washington and other commemorative pieces, for which at least 62 metric tons of silver was used in 1983. The L.A. Olympics gold coin contain 0.484 troy ounce of gold. Sales may go above 10 million coins by end-1984. As of mid-August 1984, more than 3.68 million Olympic coins, (3.32 million of silver), had been sold. The coins were priced in such a way as to avoid any cost to the government. Coin output will cease at end-1984.

The George Washington half-dollar was the first United States 900 fine silver coin issued in 18 years and the first such U.S. commemorative coin in 30 years. Official production began with the striking of Proof coins in San Francisco and Brilliant Uncirculated coins in Denver. The obverse bears an equestrian figure of George Washington surrounded by the inscription, GEORGE WASHINGTON/250TH ANNIVERSARY OF BIRTH, 1982; the reverse is adorned by a rendering of the eastern facade of Mount Vernon, Washington's home on the Potomac River, below which rests the heraldic eagle bearing the banner "E Pluribus Unum" ("One from many"). The coins measure 30.61 mm in diameter, weigh 12.5 grams, and contain .3617 troy ounces of pure silver.

The U.S.A. as a whole typically uses between 500 to 750 metric tons of silver a year in the coinage and medallion sector at private and government mints.

The Vatican has been minting coins for over 1,000 years. In 1984, the Polish Pope John Paul II released a 7-coin set featuring themes from the Book of Genesis and approved a silver "Bread of Providence" coin, the sales proceeds of which will be sent by the Vatican to help feed the hungry of the world. See Chapter 7. The present Pope visited Toronto on September 14 and 15, 1984.

Toronto, population about 3 million, capital of the Province of Ontario, Canada, has a beautiful commemorative silver dollar in honour of the city's 150th anniversary in 1984, minted by the Royal Canadian Mint, Ottawa, Ontario, a Crown corporation. See cover. It shows a perfectly detailed modern Toronto skyline in the background with an Indian paddling a birch bark canoe in the foreground. The detail is so meticulous that even the individual panes of glass in the buildings have been reproduced. It's that kind of detail that appeals to collectors. It is made of 50 per cent silver and 50 per cent copper; weight 23.33 g.; diameter 36.07 mm.

Silver coins that commemorate athletic events such as the Olympics have always enjoyed enormous popularity among coin collectors throughout the world, and in March 1983, Canada unveiled a new silver dollar celebrating the holding of the 1983 World University Games from July 1 through 11 in Edmonton, Alberta, Canada. This is the first time a country has minted an official coin of the realm to commemorate the World University Games. Sales of the silver University Games dollar were strong for the 667,179 coins produced.

As in the case of the 17 previous commemorative Canadian silver dollars issued since 1935, this coin for the Universiade has a distinctive design featuring a track and field athlete and a victory ribbon twisted to form the letter 'U' for university and the lower case 'e' for Edmonton. In their rendition of the victory ribbon, Canadian engravers used a centuries-old tradition to identify the ribbon's five colours — representing five continents — through the use of five different line patterns. In 1982, over 730,000 Canadian commemorative silver dollars were issued to collectors and it is estimated that demand for the Universiade dollar, which is 50 per cent silver, has a diameter of 36.07 mm and weighs 23.33 grams, will be significantly greater.

Additional information may be obtained from the Royal Canadian Mint, Crown Corporation, Ottawa, Ontario, Canada.

Another very interesting coin comes from Canada. Each year the Royal Canadian Mint commemorates a major Canadian historical event or theme with the issuance of a commemorative silver dollar. The silver dollar, with its striking rendition of a bison's skull, the Saskatchewan legislative building in the background, and the words "CANADA.DOLLAR.1882 — 1982.REGINA", commemorates the centennial of the City of Regina, Saskatchewan and symbolizes an interesting story about the city's history. It is of 50 per cent silver, containing 11.66 g. of silver each. The Royal Canadian mint used many tons of silver to make them.

Before wheat and before oil, there was the bison (called the buffalo in error). The bison was the Indians' major source of food, clothing and shelter and, to some extent, their utensils and weapons. After the kill, the bones were heaped into a pile that reached 6 feet in height and some 40 feet in diameter. The Indians believed that the passing herds would be attracted to the burial ground of their brothers, thus ensuring an ever plentiful hunt. Thus, the settlement where Regina is located was called "Pile O'Bones" until 1882 when the Canadian Pacific Railway stretched its iron tracks into the settlement, and "Pile O'Bones" was renamed Regina, ("Queen" in Latin), in honor of Queen Victoria.

The Regina commemorative dollar of 50 per cent pure silver measures 36.07 mm in diameter, weights 23.33 grams, and may be obtained from the Royal Canadian Mint, Ottawa, Ontario, Canada.

Incidentally, the highly successful Canadian Maple Leaf gold coins have absorbed about half of Canada's newly mined production of gold, (third largest in the world), in recent years. 95 per cent of them are sold outside Canada and 45 per cent are sold in Japan alone. The Maple Leaf now enjoys 23 to 25 per cent of the world gold coin market and has gained on its main rival, the South African Krugerrand.

Sales of the Canadian Maple Leaf gold coin became roughly equal to sales of the Krugerrand in the U.S. and Canada in the second half of 1984. The Royal Canadian Mint in Ottawa, Ontario, that makes the silver and gold coins, is the largest gold refinery in the Western hemisphere. It is the third largest in the world, after South Africa and the Soviet Union. It refined more than 118 metric tons of gold worth about U.S.$1.4 billion in 1983.

The numerous special issues make the Royal Canadian Mint a large buyer of silver.

Coin production in gold at the R.C. Mint has gone from one metric ton in 1973 to 33.5 metric tons of gold in 1983. About 31 metric tons of gold in Maple Leaf coins were sold in 1983.

Great Britain issued a sterling silver (925 fine) 1 Pound 1983 coin for collectors. The new circulating 1-pound coin, vaguely gold in colour, first issued in 1983, carried the Royal Coat of Arms on the reverse. The 1984 coin featured the Scottish thistle. The 1985 version features a leek and crown, bearing the Welsh inscription "Pleidiol wyf I'm gwald", "True am I to my country". The pound note has not been issued since December 31, 1984 and will not circulate after the end of 1985.

On Maundy Thursday, the day before Good Friday, in a custom dating from the Middle Ages, the Queen distributes the Royal Maundy (especially minted silver coins), as alms, to as many elderly poor persons as the years of the sovereign's age. Formerly, the monarch washed their feet as well.

France increased its issues of legal tender silver coins by minting 5 million 900 fine silver 100-Franc coins, measuring 31 mm and weighing 15 grams, and depicting the Pantheon church in Paris. The traditional medium for the French gold investor has been the Napoleon gold coin, containing 5.9 g. of gold.

Italy commemorated the 2,000th anniversary of the birth near Mantua, Cisalpine Gaul (northern Italy), of the poet and philosopher, Vergil, (Publius Vergilius Maro) with an 835 fine silver 500-

Lire coin in 1982 which features a portrait of Vergil on the obverse and a bull and horse facing a tree on the coin's reverse. Vergil was a Celt by origin. Both mottoes on the reverse of the Great Seal of the United States reproduced on the one dollar bill were adopted from lines written by Vergil.

Other countries issued silver coins to promote international causes such as the International Year of the Child and the International Year of Disabled Persons.

Austria issued 1.1 million specimens of 640 fine silver 500 Schilling coins commemorating the 200th anniversary of the death of Empress Maria Theresa of Austria, Queen of Hungary, and, in effect, the birth of one of the world's most popular coins — 1780 Maria Theresa Thaler (dollar).

The silver coin commemorating the death of Maria Theresa reminds us of silver's historic and respected role as an international store of value through the centuries. A restrike of the famous silver 1780 Maria Theresa Thaler and the 1967 silver 25 Schilling Austrian coin commemorating the 250th anniversary of the birth of Empress Maria Theresa are also available.

For the first time in its history, Austria will use sterling silver in its 1983 coinage by issuing four 500-Schilling commemorative coins struck in 925 fine silver.

The Mexican Government in 1984 issued a new 99.9 per cent pure silver "Libertad" one Troy ounce coin, called the "onza" (ounce). It is minted by the first mint in the Americas, the 450-year-old Casa de Moneda, Mexico City. It will be marketed in the Southwestern U.S. The first shipment of 200,000 coins was made at the end of August. Sales of this coin could reach 310 metric tons of silver a year.

Private issues of silver "coins" or medallions are growing rapidly.

The U.S. Sunshine Mining Company's Bullion Division commenced marketing its 99.9 per cent pure silver one ounce "coins" to commemorate the opening of the mine in September, 1884, (discovered by two farm boys from Maine). They are also called "rounds". They sell at about 25 cents above the spot market price for silver. Only 5,000 will be struck.

Coeur d'Alene Mines also offer its shareholders a limited 99.9 per cent pure silver proofed "coin".

A limited number of one troy ounce 999+ fine silver Proof medallions are being made from the ore, i.e. the silver bearing rock mined a mile under the surface of Idaho, converted into fine silver for thousands of products used in industries and homes. This silver comes from Hecla Mining Company's Lucky Friday Mine.

These beautiful silver pieces are individually packed in clear plastic capsules to protect the sparkling allure of the silver.

Pegasus Gold Corporation has a gold-silver operation in Montana and sells pure silver 999 fine proof medallions weighing 31.1 g., within mintage limited to 15,000 pieces of double striking.

Engelhard Corporation has redesigned its American Prospector silver medallions, which have been successful sellers for many years.

An estimated 5 per cent of all silver consumption in the world currently goes into coins. 76 countries including Canada, the U.S., Finland, Morocco, South Korea and Tonga now produce issues of coinage silver, usually legal tender.

More silver is being used for new coinage today than is being recovered from the melting down and refining of old silver coins. Remember also that every time silver coins, particularly U.S. coins, are melted down, it increases the value of the shrinking number of the surviving coins somewhat.

The U.S. paper dollar today is estimated to be worth only 3.4 cents of its 1940 constant dollar value. The present Canadian paper dollar is worth even less in U.S. currency. However, U.S. 1940 silver coins are worth far more now than then. U.S. coins used to be made of 90 per cent silver and Canadian coins were 80 per cent silver and millions of these are still held by investors.

A bag of badly named, so-called "junk" silver holds 715 troy ounces of U.S. dimes, quarters and half-dollars containing 90 per cent silver, i.e. those minted before 1965. "Clad" silver bags have 295 ounces in 1965-70 Kennedy half dollars of sandwich "clad" structure containing 40 per cent silver. A bag of 1878-1935 90 per cent silver dollars weighs 755 ounces.

Pre-1965 U.S. silver dimes, (and perhaps quarters) are to be preferred for hoarding purposes because, in times of real emergency, one is then equipped to conduct many more small day-to-day purchases and transactions (for the purchase of food, fuel, etc.).

COUNTERFEITING

The counterfeiting of silver coins is relatively easy, at least as far as the density is concerned. The density of silver can be duplicated by any one of thousands of base metal alloy combinations. If your eyes are not well trained enough, an assay by a laboratory is the only answer. The sound test, throwing down a coin to test its "ring", is not recommended on a U.S. silver dollar or Canadian silver dollar as it may damage the rim and depress its value, if uncirculated. Silver bars are the easiest to counterfeit and only a test in a laboratory can protect you. The first major attempt to counterfeit gold and silver coins and bars in Hong Kong was uncovered by police in 1984.

Some people may be shocked to learn that there are so many counterfeit silver coins (and gold coins) in circulation in the markets that, in Western Europe and Latin America, prices for counterfeit coins are frequently quoted quite openly.

In some countries, it is quite legal to counterfeit gold and silver coins of other countries. The target chosen is naturally the high premium coins. Consider this, they can take the same amount of gold, one troy ounce, that would go into a South African Krugerrand coin, and make a gold U.S. double eagle coin worth twice as much or more. Typically, the counterfeit ("genuine fake") high value gold and silver coins contain the correct amount of gold or silver.

A great number of these counterfeit coins contain the precise amount of gold or silver, as laid down by the original official mint.

Counterfeit BU (Bright Uncirculated) U.S. or Canadian silver dollars cannot be detected by a single density test — at least, it is not conclusive. Only an expensive assay of each coin can be trusted.

Let the buyer beware.

6.2.4 JEWELLERY

The silversmith's objective in jewellery is always to utilize the high reflecting power of the silver metal and to increase the play of light on its already beautiful white colour.

U.S. consumption of silver in jewellery was at its peak in 1975, when the price was U.S.$4.42 an ounce. In 1979, at $11.09 an ounce, consumption of silver in jewellery fell to $1,830 tons.

Europeans have cherished sterling silver for fine jewellery for centuries and as a result, they have long worn sterling silver jewellery with pride. According to many Canadian jewellers, the same thing is happening in Canada now.

Demand by jewellery manufacturers in 1984 is expected at 830 metric tons of gold, compared to 746 tons in 1983.

This new popularity of sterling silver jewellery originated in fashion-setting Quebec, but has now gained momentum in other parts of Canada. This trend has been youth-oriented, but demand has quickly spread to other consumer age groups because of sterling silver jewellery's low price, styling, freshness and versatility.

Canadian Jewellery Magazine recently commented, "Silver jewellery is no longer equated only with the folksy styles of aboriginal people, 'peasant' looks from various continents or simply cheaper versions of gold merchandise. 'Bold', 'striking,' 'tailored', and 'elegant' are some of the terms manufacturers and retailers are using to describe what is selling now. Indeed, to be marketable, designs have to be fresh and smart looking. The tailored pieces need to complement classic clothing suitable for the working woman, while splashy and bold designs should highlight the latest fashions."

Silver's reasonable price enables designers to produce larger, heavier, more imaginative prices that appeal to people of all ages, but a definite following is found among young consumers who favour a bold, modern look.

The youth market forms a large portion of the Canadian consumer market and this offers retail jewellers a strong incentive for carrying sterling silver jewellery because Canadian jewellers believe that young people who now buy silver jewellery pieces for less than $20 will probably become clients of their favourite jewellery stores, gradually buying higher-priced jewellery as their earnings increase.

All sterling silver jewellery is enjoying increased popularity today and some items such as two-tone earrings, three-colour collars, hand-crafted bangles, wide, bold bracelets and fine old fashioned silver lockets, are enjoying particularly strong demand. Popular men's lines include sterling silver collar bars, tie pins and key chains.

Crystals of pure silver form a uniquely beautiful pendant on a sterling silver chain. These delicate natural silver crystals, "The Tree of Diana", (no two are alike), see the Glossary Appendix, are encased between two clear watch glasses bound by a sterling silver ring.

Current sales of sterling silver jewellery crafted in Mexico have been the greatest in 28 years. They cover a wide range from sterling earrings at $5 to sterling necklaces up to $700. The artisans are creating sophisticated designs as well as their traditional pieces.

Of the 350 million women in India, many wear abundant sparkling silver jewellery, not only enhancing their beauty, but providing them with financial security. In the Hindu tradition, it is what a woman can wear that is recognized as her own property under her own control. So myriads of stunning silver bracelets, necklaces, earrings, coiffure decorations and other valuable silver ornaments are sought after and cherished by the little girls, the brides and the matrons of India. And the appreciation of beautiful silver jewellery is increasingly reflected in the rest of the world.

6.2.5 WHITE GOLD JEWELLERY

A predominant amount of silver, in alloys with 15 per cent nickel or zinc, or say a range of 10 — 20 per cent, but 12 per cent if palladium is used in an alloy, produces "white gold", an alloy with various compositions.

White gold is used as a setting for diamonds because it looks like platinum, but is much cheaper. Another alloy is 18 karat white gold (75 per cent good, 17.8 per cent nickel, 5.47 per cent zinc and 2.23 per cent copper). The nickel addition gives the white colour in that case.

Silver and Palladium form a silver white alloy with gold. Fortunately, palladium, a cheaper metal than gold, is a more effective whitener of gold than expensive platinum. The palladium-gold alloy is ductile and easily worked, in contrast to the cheaper nickel-gold alloy.

White gold alloys were originally developed as (less expensive) substitutes for platinum. White gold looks something like platinum but is much cheaper. (It may be considered to be the poor woman's platinum).

RINGS OF WHITE GOLD — RHODIUM PLATED

Rhodium plating can be successfully applied to low-carat white gold rings which are high in silver content and which contain little or no nickel. They are much less sensitive to local corrosion, (caused for example by perspiration from the hands or arms in hot humid climates) after being rhodium plated.

On yellow gold engagement rings with one diamond, the claws or prongs that hold the gem are often rhodium plated to highlight the whiteness of the diamond.

SEARCHLIGHT REFLECTORS AND MIRRORS AND JEWELLERY

Rhodium plating is an important use because its surface is hard and brilliant. A tarnish resistant electro-deposited rhodium coating is used on white gold jewellery and costume jewellery and on silverware and on searchlight reflectors of high reflectivity. It is sometimes used instead of much cheaper silver in putting a final extremely thin reflecting layer on a silver mirror, since rhodium does not tarnish and does not need polishing.

COLOURED GOLDS

A white gold article like a ring may actually be more valuable than one of regular gold, depending on the alloy chosen and the cost of the labour involved. The range of colours can run from "pale green" to "red". Gold's natural "yellow" is retained in an alloy with copper-silver. Copper gives a "pink" or "red" tint. A "rose" colour is produced by 75 per cent gold, 5 per cent silver and 20 per cent copper. Gold with 25 per cent silver, or a proportion of zinc and cadmium, results in a "greenish" tint. A "pale green" alloy is 75 per cent gold, 22.5 per cent silver and 2.5 per cent copper. Iron gives gold a "bluish" tint. A gold alloy of 20 per cent aluminum gives a fine "purple" alloy. Various percentages of metals such as zinc, cobalt, etc. also effect the colour and physical characteristics of the karat gold.

South Americans seem to prefer red golds, while many Europeans go for the lighter colour golds. The U.S.A., West Germany and the Arab world prefer yellow gold. The Japanese prefer "white gold". Pink, white and yellow gold chains woven into a single necklace have attracted attention.

IMPURITIES

Jeweller-manufacturers prefer to start with gold that is as pure as possible when preparing jewellery alloys. Osmium, one of the expensive platinum group metals, is an impurity which is particularly disliked — even in minute quantities within the gold. In a jeweller's gold alloy, a tiny speck of osmium might streak the highly polished surface of a fine piece of gold work.

6.2.6 SUGGESTION BOX AND RECOGNITION OF PERFORMANCE OF INDIVIDUALS

Suggestions by individuals for improvements in plants or the achievement of outstanding sales or other performances in industry, mines and in governments are often recognized by the award of a silver ring, or a pendant or a medallion or similar items in gold or silver.

Firms such as Bank of America, Blue Shield, Oldsmobile, Yamaha and Sony use such rings and medallions as corporate awards for suggestions used.

Northern Natural Gas had suggestions which saved the company over 1 million dollars in one year and it regularly awards such rings in recognition. See Chapter 6.2.43.

6.2.7 DECORATIVE

Many jewellers in Canada and the U.S. offer such easily affordable sterling silver items as a four-piece table setting for only $280, a silver wine goblet for $195, a rich silver candlestick for $180, a delightful set of four silver cordials for only $355, and a very special sterling silver jigger, with an Eisenhower silver dollar piece adorning the bottom, for $95. A sterling silver gift is as lasting and as special as the day it celebrates and nothing satisfies like the alluring lustre of sterling.

Sterling ware sales were experiencing a sizeable pick-up, even though it still is perceived to be expensive.

Seamless silver tubes are used to make silver napkin rings, ornamental bangles and as bands for pens, pipes and umbrellas.

6.2.8 SILVER TABLEWARE (Holloware and Flatware)

The approach of each spring and summer witnesses the revival of traditional sterling silver gifts for the June bride. This renewed preference for table settings, trays, plates, tea sets, vases, wine goblets and candlesticks comes as no surprise for people have long recognized both the usefulness and the lasting beauty of these treasured gifts that serve as permanent reminders of that very special wedding day.

Reflecting the return to this tradition are several exciting new sterling silver flatware patterns.

Lovely and charming sterling silver gifts might also include tiny charms or Christmas tree decorations, many costing less than $28, or a four gram 999 fine silver ingot on a silver chain — an interesting conversation piece for less than $22.

There is also the unquestioned elegance of beautiful sterling silver flatware, or sterling silver reproductions of museum flatware. Early in January, 1985, the average price for a 4-piece sterling silver place setting in the U.S. was between U.S.$75 and $150. To complement sterling silver place settings, a gift of a sterling candelabra, or a sterling silver fruit bowl — costing between $150 and $1,500 — would certainly be appreciated by any family.

Whether it's tableware or something to wear, if it's sterling silver, you know it will be a gift that will be appreciated for its beauty, its durability and its continuing intrinsic value.

The silverware, silverplate and jewellery industries consumed 15 per cent more silver in 1981 than in 1980, but the 2,063 tons used were still 30 per cent below the levels achieved in 1977.

Many collectors believe that only the French can compete with the British and Irish in the craftsmanship of silverware, holloware, tableware etc.

A typical first-rate antique silver holloware piece went from U.S.$150,000 in 1982 to a record $400,000 in 1984. One English silver tray went for $230,000 in December, 1984. American old silver objects are more expensive than English or Irish, because there are less of them.

GEORGIAN AND MODERN SILVER

Ireland has produced jewellery in precious metals for 26 centuries, believe it or not. In 1973, the country's silversmiths set what was then a production record, using over ten tons of silver (over 300,000 troy ounces) to make 56,000 pieces of jewellery and sterlingware.

One of the reasons for the record output was that the silver makers decided to help celebrate Ireland's entry into the European Common Market by decreeing that every piece of sterling made during the year would bear a special hallmark; the symbol chosen for the mark was the design of the Gleninsheen Gold Collar that dates from the 7th century B.C. of over 2,600 years ago, which is a prized possession of the National Museum in Dublin. The crescent-shaped hallmark, with the figures 1973 in the centre made every silver piece manufactured during the year an instant collector's item.

This was the second time in recent years that Irish silver makers used a special hallmark for a single commemorative year, the previous occasion having been in 1966 which was the 50th anniversary year of the Easter Uprising. On both occasions, the commemorative appeared to be very effective as a promotion and encouragement of sales of silver artifacts.

Ireland's long standing reputation for fine silver seems to be growing rather than declining; well over 200 current "punches", or individual silversmith's hallmarks, are registered at the Assay Office in Dublin Castle. Among the leading silverware firms are Royal Irish Silver, Irish Silver Limited, and Allwright and Marshall. The Seamus Colgan firm specializes in sporting subjects of animals and birds in silver, while the others reproduce the beautiful old Irish Georgian designs or their own house patterns that have as distinguished traditions as any silvermakers in the world.

Of the outstanding silversmiths, the very talented Peter Donovan, Brian Clarke, Michael Hilliar, Padraig O Mathuna (O'Mahoney) have been prominent.

The Kilkenny Design Centre is the operating site for several smiths and has been influential in creating modern patterns and styles. Its success, according to Brenda Weir, writer on silver in Ireland, is partly attributable to the interest in reviving ancient Celtic designs. She also reports that there has been a decline in demand for ecclesiastical pieces such as chalices, trays and bowls, so new markets have been sought and new styles have appeared.

However, political events in distant places have also affected the fortunes of Ireland's silverware industry: a remote revolution or uprising is often accompanied by looting and among the first things to go, it seems, are the treasures of churches which are seldom forcefully defended in times of civil strife. So, in the past, when there has been political mayhem somewhere in the world, it has often been followed with a flow of orders to the makers of ecclesiastical silver in Ireland.

ELECTRONIC AND ELECTRICAL USES

Silver and gold tend to be used together in the design of electrical and electronic components because of their special physical properties.

Demand from the electronic and electrical sectors appears poised to increase, perhaps taking over first place in silver consumption by 1990.

There has recently been a distinct improvement in orders for silver conductors and contacts, in spite of vigorous overall efforts to reduce the silver content.

SWITCHING OF ELECTRIC CURRENT

Silver is used in components in switchgear, computers and thermostats.

Miniature discs of silver hardened with tungsten carbide or molybdenum tap together and switch electric current from wire to wire in automobiles and lights, (varied as silver plating in telephones and computers).

Your dishwasher timer may have 50 such electrical contacts, which open and close without excessive heat or friction because silver is a natural dry lubricant. This is why it is used to plate the bearings of Space Shuttle engines, jet engines and diesel locomotives. The cost of silver for plating switch contacts, of which millions are produced annually, is normally less than 3 per cent of the end item production cost.

But surely, one says, silver tarnishes. Yes, it does. However, the tarnish is silver sulphide (not silver oxide) which is second only to silver metal itself in its electrical conductivity. So, the electric current still flows in the contacts and switches in your refrigerator, dishwasher, mixmaster, vacuum cleaner, electric toothbrush etc.

During freezing winter nights, silver quietly helps millions of people in thousands of towns and cities throughout the world to maintain a comfortable degree of warmth in their homes. This is accomplished by innumerable thermostats containing tiny silver contacts which control electric blankets and furnaces.

Silver is re-emerging as major constituent of high-performance contacts for electronics and telephony as a consequence of new alloy studies. New silver alloys have been developed to withstand severe erosion incurred by high-power circuit breakers, to be resistant to "seizing" in automatic system controls and in other electrical applications, by a comprehensive study of silver-rich alloys with carbides, nitrides and borides.

TELEVISION SELECTOR

A platinum-gold-silver alloy is used as a surfacing on television channel selector contact springs.

TELEVISION VIDEO CASSETTE RECORDER TAPES

These TV VCR tapes use silver and it is a rapidly escalating market. If there are some 120 million TV sets in North America and if quite a number use say 5 or 6 video cassettes a week each, a very large amount of silver will be used eventually.

ELECTRONICS

Consumption of silver in electrical and electronic applications will increase very noticeably because of strong growth in new electronic developments. Silver-plated copper has replaced gold in lead-frames.

Silver continues to replace gold faster than base metals replace silver. The trend today is toward less palladium in alloys and eventually, perhaps more silver.

There are now new ways of using silver to fabricate very small switch contact rivets for use in miniature electronic devices.

Recovery of silver from electronic scrap is very low because of small unit usage.

Silver powder is used in electronics.

COMPUTERS AND TELECOMMUNICATIONS

Early in 1984, Engelhard U.S.A. began marketing a new group of silver-palladium powders for use in fabricating complex multilayer ceramic capacitors, which are used in computers and telecommunications systems.

A light-activated switch, using a silver cyanoquinodine compound, can switch between two stable states ten times faster than the magnetically activated switches now in use.

HOME VIDEO GAMES

Silver, gold, palladium, nickel and rhodium plating processes formulated by Engelhard and other firms ensure consistent high quality production of printed circuit boards. These devices help bring computers, telecommunications systems and home video games to life.

THICK FILMS ETC.

Thick films, pastes, powders and dielectrics made of silver, gold, platinum and palladium, prepared to the electronic industry's exacting standards, are primary components in the fabrication of multilayer circuits, capacitors and resistors used in state-of-the-art industrial, medical and military applications.

6.2.10 ELECTROPLATING

Several new developments have taken place in the cyanide-free electroplating of silver.

6.2.11 SILVER POWDERS

In Canada, non-polluting processes have been developed for producing pure silver powder from silver-containing ores.

6.2.12 MEDICAL AND DENTAL USES OF SILVER

Silver has many more medical uses than gold.

Silver can be inserted into the human body and left there for long periods without any ill effects. It resists the acids of food, cooking and digestion.

Thin silver plates have been used after trephining the skull. Silver wires have prevented the movement of broken bones. Silver draining tubes were used by surgeons for several centuries. These applications recognize silver's bactericidal properties.

Silver is a bactericide (bacteria killer); i.e. it will activate oxygen to kill bacteria.

Silver possesses, to a marked degree, the property whereby minute quantities of the metal or certain of its salts kill bacteria — the oligodynamic effect. Generally speaking, the effect of solutions of silver nitrate in concentrations of less than 10 parts per million is to cause oligodynamic death of organic matter.

Concentrations above 10 parts per million cause ordinary or poisoning death of organic matter.

A drug is basically a poison with desirable side effects.

Silver nitrate can be used in different ways to achieve different results. It will act as an astringent, an irritant or a caustic, depending on the strength of the solutions used and the duration of their application.

Optical fibres are made of silver chloride in Israel instead of glass for improved infrared transmission in surgery and many other applications.

Silver-containing antiseptic protective coatings and coverings are made in Germany to reduce transmission of disease, for door knobs, handrails and toilet seats.

FRESH DRINKING WATER

Silver is being employed in increasing amounts as a catalyst in some water purification processes. Hospitals purify their drinking water with silver-treated carbon filters. European airlines use silver to purify drinking water.

Ancient man long ago discovered that water stored or carried for any length of time in silver vessels remained purer than in earthenware or other containers.

It appears that the old habit of cowboys in the West dropping a silver dollar in the pitcher of water by their hotel beds or bedrolls might have had a point.

The houses of personnel living on the property of the rich state-owned Pueblo Viejo gold and silver mine of Rosario Dominicana, S.A. in the Dominican Republic are all equipped with effective silver water purifiers manufactured by Katadyn Products, Wallisellen, Switzerland.

These ceramic filters of fine porosity, impregnated with metallic silver, give the Pueblo Viejo houses pure delicious drinking water by trapping most of the waterborne bacteria in the tiny pores of the filters, where they are eliminated by silver's bactericidal action. Many of the largest bottling plants in the Dominican Republic use the Elecktrokatadyn system which electrolytically adds a minute quantity of silver ions to the water — a process which stops any bacteria but is harmless to higher organisms.

American Water purification, Concord, CA, has become a leader in a growing industry consisting of manufacturers of water treatment equipment. It products use silver-infused charcoal filtration units to help its "Water Washers" remove particulate matter, dirt, sediment, chlorine and organic chemicals from the water systems of homes, industries, commercial and sports establishments.

The home owner can eliminate most undesirable odors, colours, tastes, and chemical residues, such as chlorine, pesticides, insecticides and chemical wastes, by purchasing and using the attractive Counter Top "Water Washer" which also features its own drinking fountain. A handy sanitary drink right from your own faucet. No glasses to pile — all courtesy of silver-infused filtration systems. American Water Purification also offers two under-the-sink "Water Washer" models and an efficient Portable "Water Washer" for anyone who travels.

For the air traveller who frequently ventures into less developed parts of the world, there is the Super-Straw Pocket "Water Washer". This inexpensive unit will filter 40 quarts of water before it stops water from passing through the filter. When this happens, it is simply thrown away and replaced by another of the convenient pocket units.

SILVER COMPOSITIONS TO TREAT BURNS

Surgeons disinfect burns with silver creams, often with silver phosphanilate as a potent antibacterial agent to protect against infection during the healing process.

Silver sulphadiazine, a sulphonamide, saves the lives of many burn victims. It is applied to exposed tissue. This soothing silver compound prevents bacterial growth that can lead to infection and death.

Thousands of the world's hospitals use silver sulphadiazine to treat hundreds of thousands of persons on every continent who are hospitalized each year for serious burn injuries.

To understand the seriousness of burns, one must understand the importance of skin. A recent report of the Washington Hospital Center of Washintgon, D.C. noted that skin "shields us from armies of hostile microorganisms, all eager to wreak havoc inside the body. When a severe burn destroys the skin, it is destroying our defenses against devastating fluid loss, deadly infection and uncontrolled temperature extremes," and in the case of the most serious burns, "the wound becomes a fertile breeding ground for infection and an immediate danger to life."

"Silver sulphadiazine cream is used to effectively combat the very grave risk of infection because it can eliminate hundreds of organisms, including Gram-positive and Gram-negative bacteria and fungi and by being applied directly to the burned area, the silver sulphadiazine cream can overcome bacteria when standard antibiotics do little good because the blood vessels that might take them to the injured area have been destroyed. This cream also has remarkable healing properties which help speed the patient's recovery," according to the doctor whom the American Burn Association honoured for his pioneer research in this field, Charles L. Fox, Jr., M.D., Professor of Microbiology, Columbia University College of Physicians and Surgeons, New York.

A report by Marion Laboratories, Kansas City, MO, manufacturer of Silvadene Cream (silver sulphadiazine, micronized), indicates that in addition to the healing powers and germ-killing efficacy of this compound. Silvadene Cream's application on burned patients is virtually painless. Frequent applications of Silvadene are not needed. Dressings are nonadherent and easily changed without the use of analgesics. When burns are well-covered, patients feel warm, there is less loss of heat, and surface evaporation of water is diminished. It does not stain linen, dressings, or patients.

Silver sulphadiazine creams are also manufactured as Flamazine by Smith & Nephew, London, England and by Smith & Nephew Ltd., Lachine, Quebec, Canada. Philips-Duphar Nederland, Amsterdam, The Netherlands, produces it as Flammazine. The silver sulphadiazine composition is also produced in Germany, India, Israel, Mexico and Spain, extending its healing benefits throughout the world.

An unexpected synergistic action between silver sulphadiazine and the silver salt of a quinoline carboxylic acid promises to be very important for the treatment of burn wounds. Some strains of bacteria, including *Pseudomonas Boston, Pseudomonas Mangalore*, and *Pseudomonas 181*, have developed a resistance to customary silver sulphadiazine treatments. As reported in the January 1983, issue of *New Silver Technology*, a silver salt of a quinoline carboxylic acid is effective in killing these treatment-resistant bacteria, but only if the ointment contains at least 30 millimoles of the salt per kilogram of cream. It is now found that the same bacteria are very well controlled by a cream which contains only 3 millimoles of the salt per litre of cream, together with 30 millimoles per litre of silver sulphadiazine.

Hundreds of thousands of burn victims throughout the world owe their recovery to the healing powers and germ-killing efficiency of silver sulphadiazene.

Now laboratory tests reveal that silver sulphadiazene is effective in killing *Trypanosoma rhodesiense*, a dreaded parasitic protozoa that causes the most serious type of African sleeping sickness, trypanosomiasis, according to a report by the Division of Experimental Therapeutics, Walter Reed Army Institute of Research, Washington, D.C. summarized in the January 1983 issue of The Silver Institute's publication, "New Silver Technology". Treatment has been by arsenical drugs.

Carried by the tsetse fly, this protozoa is responsible for making an area of nearly four million square miles in Africa unfit for human habitation. Victims of sleeping sickness may experience a fever as high as 106°F (41°C) for several months, heart palpitations, difficulty in walking or speaking, and in the final stages, emaciation and a prolonged comatose state. The survival rate is 50-50. Efforts at killing the parasite-carrying insects have not been successful and in some cases relocation of entire villages has been easier than destruction of the insects. In addition to infecting humans with a bite, the tsetse fly attacks cattle, horses, dogs, and donkeys.

In vivo studies of mice infected with *Trypanosoma rhodesiense* show that if left untreated, the infected mice die in 4.2 days, but the mice treated with silver sulphadiazene recover completely, becoming totally free of the parasites. Silver sulphadiazene and other silver sulphonamides represent a new class of medication for use in the fight against sleeping sickness, and the only type that can be administered orally. The use of these silver compounds can offer new hope for the future development of areas of Africa now plagued by sleeping sickness by providing people and their livestock with a healthier environment. It is not known whether it will treat the Graii variant.

Thus more Africans will live and in turn will have children, increasing the population, thus influencing the distribution of available food there and indirectly adding to an increase in silver consumption in the world.

The white sticky "ointment" that is put on your chest to enable the flat discs to adhere, with their wires going to the electrocardiogram machine, is partly made up of silver/silver chloride, which improves the flow of electrical information from the heart to the recorder.

SILVER IONS

To eliminate deep infections, silver ions are transferred deep into infected tissues via a very low electric current. Silver ions are also used to Prevent mastitis, a bacterial infection of cow's udders.

BIOELECTRONICS (ELECTRIC BIOSTIMULATION)

Bandages with Electric currents

The application of mild electric currents to silver-coated textiles when used for bandages, provides a stream of silver ions into a wound which inhibits the growth of bacteria.

Bandages made with silver salts impregnated in carbon fibres provide durable anti-bacterial protection for common and severe wounds.

If manufactured in the form of area garments, mild electricial charges can provide nerve stimulation for those paralyzed as a result of an accident.

Clinical testing of these medical applications is proceeding and promising results are being reported.

The potential uses of silver-coated fabrics in the field of medicine are arousing great interest in this material.

Silver is used as an electrode. When inserted in the casts for broken bones, mild electrical currents may be applied to the silver-coated fabric to encourage bone growth. This is somewhat similar to another use of silver electrodes to assist in bone healing. The first recorded case of a broken bone being mended by electricity was at St. Thomas's Hospital, London in 1812, 173 years ago.

Surgeons also mend bones using cement containing anti-bacterial silver salts. In any case, human bones accumulate tiny traces of silver quite naturally, as do trees, algae and seawater.

Dr. Nigel Dwyer, consultant orthopaedic surgeon at the East Birmingham Hospital has described electricity's effect in healing ulcers and causing bone to grow and knit. Bob Simonis, head of a bone clinic in St. Nicholas's, Surrey reports a

75-80 per cent success for knitting together apparently irreparable bones this way. Professor Bjorn Nordenstrom of Karolinska Hospital, Stockholm has had similar success treating breast and lung cancer patients, using electromagnetism on those considered beyond other treatment.

The use of small electric currents to stimulate bone growth to new bone structures and the healing of burn wounds is about to become established medical treatment. These require excellent conductive media such as the silver salts that are, of course, also bactericides and totally neutral to the human systems. Similar electrical techniques, (microwaves fields pulsed at low frequencies), will be used to stimulate regeneration of joint cartilage in early cases of arthritis. Electrical stimulation, combined with hormonal growth factors, grafting or injection of appropriate cells, will be used to stimulate regeneration of the spinal cord in patients with paraplegia, according to Professor R.O. Becker of Upstate Medical Center, Syracuse, a pioneer in bioelectronics, Professor W.R. Adey and others.

Electrical stimulation of regenerative growth in the human body will be applied to cardiac patients, for example, where new heart muscle will be grown and in kidney failure, new kidneys will be grown.

It should be possible in say 15 years to treat many illnesses electromagnetically, including battlefield trauma. Cells of the body would be "fooled" into producing anti-bodies, coagulants, new tissue, chemicals etc. by being exposed to certain kinds of electric and magnetic fields.

However, meanwhile, silver has largely been replaced by tantalum in, for example, surgical plates and pins.

A similar use of bactericidal materials for humans has been known by man instinctively for centuries. Wine is bactericidal and an excellent source of the mineral salts and trace elements, including magnesium, calcium, zinc, iron, sodium, potassium, phosphorus, sulphur and chlorine, without which the human system cannot possibly survive. Many such minerals have, in effect, curative properties. The ancient Sumerians of 5,500 years ago used balms and ointments with a wine base that would obviously kill bacteria. From ancient times, our forebears used wine to cleanse and asepticize wounds. The Good Samaritan poured oil and wine into the victim's wounds almost two thousand years ago. Noah planted a vine first thing after the flood on disembarking from the Ark. One cubic centimetre of white wine, mixed with one cubic centimetre of culture medium, kills 99 per cent of the colon bacilli and the bacilli of cholera and typoid. St. Paul urged Timothy to take a little wine for his stomach's sake and for his frequent discomforts. Ecclesiastes urged one to 'go thy way, eat thy bread with joy and drink thy wine with a merry heart'. Wine is beneficial in certain specific disorders. The most extensive curative properties are found in champagne and the Bordeaux. For example, champagne is notably recommended by some doctors in cases of coronary trouble, hypochlorhydria, diabetes, low blood pressure, nervous breakdown, chronic rheumatism and in convalescence and old age. All wines are allowed by many doctors, white, red, rose, dry or sweet, (except very full-bodied wines with high alcohol), in cardiac deficiency, angina, bronchitis, colitis, the flu, bladder stones and typhoid fever. All light wines, white, red and rose are helpful in constipation.

Silver and platinum are used in pacemakers and other devices that are implanted in the body.

Silver oxide batteries power hearing aids and calculators (as well as satellites and submarines).

X-RAY PHOTOGRAPHY AND OTHER USES OF SILVER IN MEDICINE

Medicine is the most important segment of photographic demand for silver.

X-ray films in hospitals carry relatively large amounts of silver anyway in order to lessen the radiation exposure of patients. The overall number of x-rays taken per person is declining, but the number of persons being examined by radiographic means is growing.

Silver halide in a new combination with polymeric materials and gelatin binders greatly improves the effectiveness of medical x-ray film.

For diagnostics, the first high-resolution phase lens for use at x-ray wavelengths is made with silver.

Physicians are now able to make instant images of what they see directly or on video monitors during diagnosis, using silver halide instant photography. In obstetrical examinations, and other ultra sound video imaging of internal organs, this is proving particularly valuable — with stereo images in colour. It is also being used in computer graphics, advertising photography and geological photography.

The addition of silver to clinical diagnostics is like having a new set of eyes, said a physician from the National Institutes of Health, Bethesda, MD. Silver complexes now allow the detection and visualization of the smallest building blocks of human cells in concentrations of as little as 10 trillionths of a gram per square millimetre.

The extreme sensitivity of silver allows the accurate assay of small amounts of cerebrospinal and embryo fluids for diagnosing disease and the prenatal condition. New York State Institute for Basic Research in Development Disabilities, Staten Island, can now, with silver, directly use unconcentrated cerebrospinal fluid to identify the antibodies that are indicators of the presence of multiple sclerosis. The National Institute of Oncology and Radiobiology, Havana, Cuba, finds silver the superior diagnostic tool for the routine diagnosis of Hodgkin's disease, a cancer of the lymph nodes.

The U.S. Department of Health and Human Services, Washington, D.C., uses silver complexes with electrophoresis, a separation influenced by an electric charge, to effect a quantitative analysis of the basic building blocks, proteins, the essential constituents of all living cells. Their detection and identification opens up the opportunity for accurate monitoring for pathophysiologic changes in disease states, diagnosing genetic diseases and assaying protein abnormalities or pathologies such as may occur in liver and heart disease.

Silver complexes, unlike others used to detect proteins, do not kill or inactivate them. As a result, the desired proteins, clearly identified by the silver complexes may be separated and further studied as active constituents in experiments.

The silver technique is useful outside medicine also. Silver protein assay provides a distinct pattern that can be used to "fingerprint" the proteins in natural foods. For example, with silver, it is now possible to detect proteins of any non-beef products which might have been added to ground beef.

The use of silver complexes for the identification of normal or abnormal proteins is a powerful new tool in the fields of health and dietetics. The fact that silver complexes are 100 times more sensitive than other means of detecting proteins means that their contribution to these fields will be significant.

Silver increases by 100 times the sensitivity for determining polypeptides, useful for the diagnosis of disease.

An improved ultra-sensitive silver stain uses a photoreversal technique to detect as little as 0.01 nanogram per square millimeter of polypeptide on an appropriate gel. A wide range of medical diagnoses is made possible by this new technology.

Prenatal diagnosis of fetal abnormalities, monitoring patho-physiologic changes in disease states, chromosomal diagnosing of genetic disease, identification of polypeptide levels in hormones and urine, and evaluation of drug therapy are just a few of the many applications possible with the sensitive silver stain.

Silver is often recovered from used X-ray films, which retain 40 per cent of the silver used, but the bulk of the films remain in files for years so hospitals are holding large amounts of silver. It is estimated that these films contain a total of well over 3,000 metric tons of silver. A ton of used X-ray film was worth about U.S.$3,000 early in 1984. In the U.S., the law in many states requires hospitals to keep X-ray films for five years and films of a child must be kept until no longer a minor. Many hospitals get round this by microfilming their X-ray films, which are then sold for recovery of the silver.

There is a shortage of X-ray film in the Soviet Union, (no doubt reflecting their chronic silver shortfall), as well as a shortage of surgical instruments and even aspirin. Therefore, recovery of silver from used X-ray film is less than it might be.

A new clinical diagnostic tool, capable of penetrating arteries without harm uses silver to advantage. The slant-pointed penetrating probe tube is optimally designed to have a diameter less than 150 micrometers. Punctures made into tissues and arteries are thus small enough so that re-sealing of the wound occurs naturally, preventing bleeding. Because the natural blood flow and mirco-circulation within the vessels are undisturbed by this small probe, accurate measurements are possible. The increased stability and accuracy of the probe tube is achieved by coating the surface of a stainless steel tube with chlorinated silver (Ag/AgCl).

The silver/silver chloride layer on the surface of the chrome-nickel steel tube serves as an accurate reference electrode for all the measurements. When the probe is immersed in the blood, this fluid allows the silver layer to form a complete circuit. All of the functions of this diagnostic tool are conveniently contained in a hand-held instrument. In the blood stream, the salt crystals redissolve, causing an electric current to flow between the salt solution and the silver/silver chloride layer. Blood flow rates may also be determined by electrodes forming a thermocouple. One or more electrodes may be designed inside the probe tube for measuring specific gases or ions found in the blood.

Scientists from Engelhard's chemotherapy research program reported to the 1984 meeting of the American Chemical Society on the development of a group of promising, new anticancer agents. In preclinical animal tests, the new complexes have displayed antitumor activity equal to or greater than that of Cisplatin, a leading anticancer drug produced by Engelhard. The new compounds are expected to play an important role in the ongoing search for new antitumor agents.

Silver catalysts produce new compounds that are not only effective sun screen lotions, but also have analgesic and healing characteristics.

DENTAL USES FOR SILVER

An amalgam of silver-tin alloy with mercury (quicksilver) can be moulded at the temperature of the mouth, after which it hardens quickly to a polishable finish.

Enhanced handling characteristics may be obtained with a new dental amalgam consisting of 24 to 45 weight per cent of silver, 28 to 42 weight per cent copper, and 29 to 34 weight per cent tin, where the atomic percentage of silver plus copper is about three times as great as that of tin.

The alloy is prepared as an admixture of both spherical and irregular particles, all at about -325 mesh in size. The mixture of shapes allows the alloy combination to have the smooth carve characteristic associated with spherical particles and also to exhibit the firmer packing and carving consistency of conventional particles. The particle size range for both components begins below a micrometer and extends to about 50 micrometers.

A particularly preferred composition is 41 per cent silver, 28 per cent copper and 31 per cent tin. The powder mixture is maintained at a ratio of about 65 per cent to 85 per cent spherical and 15 per cent to 35 irregular. Both of these particles configurations participate heavily in the amalgamation with mercury, enhancing the consistency of the mixture and the homogeneity of the amalgam.

If 52 per cent of the preferred alloy is mixed with 48 per cent by weight of mercury, the tensile strength developed in 15 minutes is about 857 pounds per square inch (6 megapascals), and after 7 days is 8740 pounds per square inch (60 megapascals); its compression strength after 15 minutes is 8320 pounds per square inch (57 megapascals), and after 7 days is 81,300 pounds per square inch (560 megapascals).

All of the physical properties of the new dental amalgam compare favourably with those of other commercial dental alloys.

Dental amalgams, (normally various alloys of silver, tin, platinum and mercury), which contain a lower percentage of silver, are now available.

The affluent countries of the world bought 53 metric tons of gold for dental use in 1983. In 1978, it was 87 tons. The mouths of U.S. citizens reportedly contain 60 metric tons of silver. In 1983, the U.S. used 17 troy ounces of gold per 10,000 people, Canada 6 ounces, U.K. 3 ounces, France 6 ounces and West Germany 78 ounces.

The cost of the silver used in medicine or dentistry in relation to the cost of the professional service is trivial. A single silver 10-cent piece minted prior to 1964 contains enough silver, about 7 one-hundredths of an ounce, for three or more dental fillings.

In the future, in dentistry, silver and gold, (despite their higher price in years to come), will still be used 15 years from now for the repair and replacement of missing teeth, but the number of people requiring these should be much smaller than it is today.

SWIMMING POOLS

In some swimming pools activated charcoal filters impregnated with silver promptly eliminate bacteria and remove the need for irritating chlorine that stings and bleaches. It frees water from coliform, pseudomonas and staphylococcus bacteria. It is better than chlorine in destroying the latter two bacteria and equal to it in maintaining essentially coliform-free pool water.

Fungicides

Silver is also used as fungicide (fungus killer).

6.2.13 SILVER AND GOLD IN WINDOW GLASS

A new use for silver is in silver-titanium oxide layers to remove frost from windows in aircraft and automobiles.

Overheating of offices and an increased load on air conditioning occurs in many modern buildings with large window areas when ordinary window glass is used.

Silver in extremely fine layers protects the heat-reflecting gold films in office window glass and reduces these problems, screening off infra-red radiation. In some double glazed windows, the heat reflecting gold-silver film is applied to the inner surface of the outer glass. This fends off about 74 per cent of the solar radiation. Increasingly, the gold is sandwiched between two dielectric layers. In some windows, gold-silver alloys are used generously.

When gold is beaten to leaf of a thinness of a 150,000th part of an inch, light passes through the gold leaf. If the gold is pure, it transmits green rays, that is, it appears blue-green when held up to the light. If highly alloyed with silver, it transmits pale violet rays. (A gold coating of only four millionths of an inch thick helps to protect men in spacecraft from the heat from rocket engines.)

When you fly in a jet aircraft, including the Concorde, remember that these aircraft have windshields impregnated with a thin layer of gold (with some silver) only one fifth of a millionth of an inch thick. The gold layer does not interfere with vision. The window appears to have a brown or gold-bronze tint from the outside of the plane and looks pale blue-green from the inside. The ultra thin layer of gold-silver also cuts down glare and blocks out the heat of the sun's rays and provides a medium for electrically heating, de-icing and demisting them. It does not alter the entry of light very much. People can see out but relatively little heat will enter since the gold-silver layer reflects much of the scorching infra red rays of the sun.

Such gold-silver layered window glass also reduces air conditioning costs in office and other buildings in hot weather.

The affluent Royal Bank of Canada headquarters building on Bay Street, the financial district of Toronto, Ontario, is an esthetically dramatic example of this. A TOTAL OF ABOUT 2,500 TROY OUNCES, (77.7 KILOS) OF PURE 24 KARAT GOLD, NOW WORTH OVER ONE MILLION DOLLARS, (over $1,000,000), bought when gold was only about $100 an ounce — plus some silver — is in the glass of 14,000 window panes of this beautiful building. The whole building gleams in the sun like a giant block of gold.

The architects said that the saving of energy was a prime reason for choosing gold-silver reflective insulating glass. Such windows cost two or three times the expenditure for ordinary windows, but the gold coating quickly saves more than it cost to install it. The gold laminated glass is on the outside surface of the inside panels of the double glazed windows.

Such gold-silver layers are often 0.000001 inch thick, sandwiched between two sheets of glass, typically one of green solex and other of vinyl-bonded glass to prevent breakage. Gold has been found to be the most energy efficient of all glass coatings, particularly where it comes to direct heat, i.e. summer sunshine protection. Wet chemical deposition is used to apply the gold to the glass by spraying on gold in a chemical solution. In the resulting chemical reaction, the thin layer of gold-silver bonds to the glass.

Silver halides used in the photographic process have long represented the largest industrial use of silver. The discovery that silver halide also imparts unique properties to glass was announced by Corning Glass in 1946. This was the photochromic glass which has the remarkable property of darkening upon exposure to light and brightening when the light is removed. It was during the development of these glasses that the color-giving properties of silver halide were discovered. The first experimentation was based on the length of time of exposure to ultraviolet light; the present work is based on the intensity of that radiation.

The uses of these colorful glasses include such applications as advertising signs, floral designs for glass walls in hotel foyers, and decorative glasses. Their absorption of ultraviolet rays makes them *useful for protective eyeglasses for those who have lost their eyes' natural crystalline lenses by cataract operations.* The glass serves instead of the crystalline lens to protect the eye from the harmful effects of ultraviolet light. When the polychromatic glass is extruded, a polarizing effect can be induced which is useful for prescription eyeglasses.

The new glass is also useful as a recording medium. Corning researchers have found that a krypton laser can instantly record information as a pattern of dots in the silver-containing glass without processing of any kind, which can be immediately read, erased and re-recorded at will.

Research into the applications of the earlier photochromic glasses that darken with light, continues. Pilkington Brothers of England have developed formulations that respond so extremely rapidly to sunlight and dark that they may be used in automobile windshields as well as in prescription eyeglasses. American Optical Corporation has developed a way of obtaining a gradient of photochromaticity over a glass sheet such that it can be used to provide a shading effect for automobile windshields. PPG Industries has shown that silver-containing glasses, when bombarded by electrons, can be made into high resolution photomasks which are durable as well as transparent, allowing for easy, precise alignment on a substrate for microelectric circuit manufacture.

The most dramatic use of the gold-silver film is probably in the visor of an astronaut's space suit. The thin film reflects away radiation, beginning in the yellow wave-length range (which accounts for its attractive colour) and extending through the entire infrared range. The reflection prevents the harmful rays of the sun from entering the space suit chamber. Gold coatings, protected by silver, allow less than 5 per cent of near and far infrared rays to come through and yet transmit an abundant 70 per cent of light in the blue-green visible range. This means that the astronaut can see clearly without his eyes becoming subjected to the painful, intense heat rays of the sun.

Moving out into the glare of a winter sun reflected on a snow-covered landscape, a skier, snowmobiler or other winter sports enthusiast will increase his or her enjoyment by putting on a pair of all-weather glasses. Through the incorporation of silver in these increasingly popular glasses, they have the remarkable property of darkening so as to stop glare when exposed to outdoor light. They also change colour to meet increasing actinic rays of the sun. Skiers and ice skaters find that the silver-gray colour of the glasses not only gives them excellent protection against direct and reflected glare, but also increases contrasts of colours and sharpens their depth and colour perception.

Pure unadulterated gold would make a superb frying pan because it diffuses heat more evenly than iron or copper. Such a frying pan was made in the U.S. Being chemically more stable than copper, iron or stainless steel, it is even less prone to impart a taste. Such a frying pan might weigh say 26 troy ounces. The gold it was made of would cost about U.S.$9,000 at current prices, apart from the fabricating cost.

New glass systems based upon silver halides are shown to be purely ionic conductors with very high conductivities and are also advantageous as solid electrolytes for solid-state battery systems.

For new communications systems, silver halides are shown to be essential constituents in glasses for infrared transmission and infrared laser communication links.

A new process for imparting spectacular coloured images in glass has been developed by Corning Glass. In this process, variations of intensity of exposure of silver-containing glass to ultraviolet radiation result in colours from pale yellow through brilliant green, blue, purple, red and orange. In addition, unwanted ultraviolet rays can be screened out. The process for making these glasses is summarized on page 26 of the April 1982 issue of New Silver Technology.

A new use is in silver-titanium oxide layers to remove frost from windows in aircraft and automobiles.

OPTICAL GLASS FIBRE CABLE TELECOMMUNICATIONS

The glass fibres that carry telephone conversations can be coated with silver to enable them to carry electronic messages in addition to the light-transmitted telephone conversations.

6.2.14 SOLAR CELLS

There are new silver developments in current collectors for photovoltaic solar cells.

Large amounts of silver could be required for new uses such as silver cells for Solar Breeders. These use silver-silicon solar panels. One built in the U.S.A. has a capacity of 800 kilowatts a day, pointing to a major new power source.

Other new uses are silicon-silver cells for solar heating, as well as mirrors for solar heating units.

Sunlight striking the surface of silicon solar cells generates a small electric current. The best way to collect the current from each cell is by way of gold plated or gold-silver alloy conductor grids deposited on the silicon cell surface. Silver wires lace silicon solar cells in criss-cross pattern.

A central solar receiver plant called Solar I is showing that solar energy, concentrated by silver mirrors, can be efficiently made into electric power on a commercial scale. Operation of the plant started with a 3-megawatt trial period and power output is gradually being increased until the full 10-megawatt capacity is reached. The plant is located in the middle of the Mojave Desert at the Southern California Edison Cool Water Generating Station in Daggett, California, an area of sun-filled days. McDonnell Douglas Astronautics Co. engineered the plant. Martin Marietta Corporation produced the 1,808 heliostats with nearly a million square feet of silver-backed glass mirror surface that make up the reflector field. Each silvered heliostat is computer driven to reflect the sun's thermal energy directly on the 24, 3 × 45 foot heat absorbing panels located on the receiving tower. Each panel contains 70 nickel alloy tubes which absorb the solar energy, and superheat steam to 950°F at pressure of 1,460 pounds per square inch, to drive the turbines and generate electricity for Southern California homes.

Southern California Edison is now inviting private industries to participate directly with the utility in a silvered mirror solar power plant 10 times larger. Dubbed "Solar 100", the 100 megawatt facility is to be located near Solar I and to be operational within the next few years, with consideration of another large silvered mirror power plant in the region by 1990.

A series of 108,864 silver-backed silicon solar cells with silver connections, mounted on 1,512 PowerLine panels, manufactured by the Solarex Corporation, Rockville, MD, will supply a peak output of 105 kilowatts. When a silvered glass mirror is included opposite each panel, additional solar radiation is reflected onto the cells, and the power output is increased by a third, to 135 kilowatts.

This novel "double silver" combination is installed on the roof of the Oklahoma Center for Science and Arts in Oklahoma City. It provides the full electric power requirements of the Center during clear days, with utility power available as a supplement at other times.

The solar power installation was designed and put into operation by Science Applications, Inc. It was financed by the U.S. Department of Energy to demonstrate the feasibility of using such a combination for commercial, industrial and institutional applications.

For the first time, a large industrial structure now exists which is completely powered by the sun. The Breeder is not connected to the public utility grid. It demonstrates the potential of terrestrial photovoltaics for large-scale application.

In this Breeder built by Solarex Corporation, a

200 kilowatt rooftop photovoltaic array of panels using silver cells converts sunlight directly into electricity to provide power for the facility's production lines, which will, in turn, produce silver photovoltaic cells and panels. Thus the Solarex Breeder will use power provided by silver-silicon solar cells on its roof to manufacture, or "breed", more solar cells.

The facility derives all of its electric power, including power for lights, air conditioning, and production equipment, from the more than 3,000 semicrystalline cell panels mounted on its roof. The Breeder's photovoltaic system, aided by solar thermal energy and thermal storage, also provides for all facility heating requirements, eliminating the need for oil or gas heating. The 200 kilowatt array produces an average of 800 kilowatt hours per day of energy coupled with a 2.5 megawatt hour battery storage system. This storage capacity provides steady, uninterrupted power of 60 kilowatts in the unlikely event of as much as four days without sunlight.

Developments in the field of the use of silver in mirroring and photo-electrics that have led to the Solarex Breeder have been closely followed and encouraged by Silver Institute staff since 1974 and reported in summaries published in its "New Silver Technology."

Silver-silicon photovoltaic — or solar — cells are now used in many parts of the world to operate water pumps, electronic microwave receiving and transmitting devices, street lights, navigational aids, radios, fans and refrigerators.

The largest photovoltaic plant in the British Isles is on Fota island, County Cork, in the Republic of Ireland.

6.2.15 Fuel Cells using Silver

The fuel cell was first discovered by Sir William Grove in 1839, using platinum electrodes. The electrolyte was phosphoric acid.

Dow Chemical Co. has developed an ingenious method for producing porous electrodes in which the tiny pores are uniformly coated with metallic silver. The powerful catalytic effect of the silver surfaces permits their use as efficient air electrodes for fuel cells, but of even greater immediate importance, when they are used as the cathodes of industrial chlorine-caustic soda cells, they produce these industrial products at substantially lower voltage and lower electric power costs.

The fuel cell is a device for generating electricity directly and continuously from an electro/chemical reaction inside a "cell" or container. Nickel plate electrodes were used by the British inventor, Francis "Tom" Bacon, in the first successful modern demonstration of a fuel cell in 1959, mixing the two common gases, hydrogen and oxygen. Bacon received some technical help from INCO of Canada. The three fuel cells which provided the electricity in each of the "Apollo" spaceships for guidance, communications, air conditioning and lighting during the 14-day flights to the moon were developed by Pratt and Whitney, U.S. licensees of Bacon's patents. Fuel cells have also been successful in the Space Shuttle program.

The first commercial-sized fuel cell to be bought solely by a U.S. utility, U.S.$25 million, 7,500 kilowatt unit begins operation in 1988, for Southern California Edison, supplying enough electricity for 2,500 homes. In the spring of 1984, a fuel cell system started generating power for Tokyo Electric Power.

6.2.16 BATTERIES

Greatly increased consumption of silver in batteries in both commercial and military applications is expected, because of expanded battery uses.

Silver batteries have twice the electrical capacity of lead-acid batteries of the same size and 15 to 20 times the capacity of comparably sized dry cells. These lighter silver batteries are vitally useful in military application, such as in equipment — torpedoes, rockets, submaries and satellites.

New are: Constant Voltage Batteries
Silver-hydrogen Batteries

The use of silver in ordinary batteries may not grow beyond a marginal level.

However, there will be new types of silver-containing batteries for aerospace and perhaps other applications. Silver will be a component in a new generation of batteries.

Silver-zinc batteries, due to their high current densities, have proved to be indispensable for land, water, air and space vehicles where the vehicle must carry its own power source on board. The steadily expanding markets for silver-zinc batteries include aircraft and helicopters, underwater research devices and navigational buoys, portable floodlights and emergency power supply for data processing machines, portable transmitters and receivers, electric vehicles, cameras, timepieces and remote-controlled hobby models.

Silver batteries made by Silberkraft-Leichtakkumulatoren, West Germany, were installed on board the West German scientific space satellites Aeros and Helios.

The silver oxide-zinc lightweight accumulator results in an alkaline battery of very high constant discharge voltages of approximately 1.8 and 1.5 volts per cell and according to the size and construction, a storable energy in the range of 70 to 120 watt-hours per kilogram, which is considerably above the values of other battery systems.

Silberkraft continues to conduct research on improving the efficiency of the silver battery. Primary battery systems using silver chloride-zinc and silver oxide-cadmium are being tested and evaluated for further important applications.

Silver oxide batteries power hearing aids and calculators, submarines and satellites.

In self-contained power sources, the addition of silver nitrate to lithium nitrate and chloride components has led to a new generation of high power-density thermal batteries.

The high-rate discharge of a thermally activated cell is improved by the inclusion of a silver salt in the battery's electrolyte. This electrolyte also contains lithium perchlorate and lithium nitrate. Due to its low melting point, the silver salt is preferably silver nitrate. Silver nitrate near the cell's nickel cathode keeps undesirable polarization of the cathode to a minimum.

Thermally activated batteries are useful for missiles and other predominantly military applications. Under storage conditions, the electrolyte in such cells is solid and has a very low conductivity. Upon being heated to a predetermined temperature, the electrolyte melts to form a conductive fluid. Lithium chloride — potassium chloride electrolytes are often used for missile systems, usually requiring operating temperatures near 500°C (932°F).

Since silver nitrate has quite a low melting point, the new cell operates at a desirably reduced temperature of 350°C (662°F). At this temperature and a high discharge rate of 100 milliamperes square centimetre, a cell potential of 2 volts is maintained for more than 7 minutes. This performance is largely attributable to silver.

6.2.17 SPACE SHUTTLE PROGRAM

Silver has a unique combination of special characteristics, such are notable resistance to heat and corrosion, which make it particularly suitable for the pumps that drive the engines in the terribly demanding, harsh physical environment in the NASA Space Shuttle's huge engines with its most extreme variations in temperature, as well as the necessity of handling pure oxygen pressurized to many atmospheres. Such a situation would destroy most metals.

Gold and silver electrical conductors are widely used in the high-technology components of all types of space vehicles.

Rocketdyne, division of Rockwell International, utilizes many properties of silver in roles vital to the Space Shuttle program.

The Shuttle engine, when operating efficiently, requires hydrogen under 6,700 pounds of high pressure at the frigid temperature of minus 360 degrees Fahrenheit. Under these conditions, hydrogen in contact with metal equipment can cause embrittlement and therefore, failure under stress.

Pure oxygen, pressurized to many atmospheres, is powerfully corrosive, but silver is immune to its corrosive power. Therefore silver plating is used on many seals in the Shuttle engine to take advantage of this immunity.

Combined with many materials, oxygen results in explosively flammable materials — even at normal temperatures and pressures. Three features make silver an excellent choice:

1) silver is more stable as a metal than as its oxide, which means that oxygen cannot burn

silver, no matter how high the temperature. Oxygen in combination with many materials results in explosively flammable mixtures. Silver plated seals exploit the advantage silver has;

2) silver is the most resistant to "sparking" from physical impact, compared to other metals. This is why the silver plated seals in the Space Shuttle prevent sparks that could set off the Shuttle's explosive liquid oxygen propellant;

3) silver also serves as a "dry lubricant" preventing excessive buildup of undesirable excessive heat in individual pump parts, over and above ambient engine temperatures, which might cause failure of the parts. Equally, such heat in the presence of oxygen could cause ignition of some pump materials, a matter of serious concern. This is allayed by putting silver seals at possible friction points to prevent overheating. Silver conducts heat better than any other metal and carries the heat away quickly from the overheated area.

Working as a lubricant, silver deforms slightly at the very surface of the seals, forming microscopic layers which slide easily over each other and over other metal surfaces, without threat to the basic strength of the silver parts.

Further protection against embrittlement and resulting failure is obtained by gold-coating the high strength nickel-base alloy turbine discs that pump hydrogen into the engines. Because oil-based lubricants are affected in the vacuum of outer space, gold is used as a lubricant.

Gold is also used in the seals between the components used to deliver hydrogen to the engines. The gold coating provides a good biting seal against the hard metal surfaces. Further, the silver and gold seals formed are "perfect" in that, even at high temperatures and pressures, they are "gastight".

The biology experiment instruments on the Mars Viking space craft probe to analyze the planet's surface, which made the exhilarating discovery that the soil there chemically mimics life processes on earth, could not have been made without silver to bond titanium and stainless steel together.

MORE SILVER LUBRICANT APPLICATIONS

Superior silver lubricant surfaces are provided for the brushes of motors used in scientific satellites.

These same advantageous properties of silver are, of course, also exploited in hundreds of uses on earth.

In engineering tests with silver solid-film lubricated ball bearings, moving in either bare or coated races, show how silver acts as a superior dry lubricant.

Research shows that steel gears in mechanical power transmissions last much longer if they are electroplated with silver.

For eight years now, 19 silver-electroplated high-speed gears have been operating flawlessly on the North Slope of Alaska. These gears, manufactured by the Philadelphia Gear Corporation, King of Prussia, PA are subject to speeds above 10,000 revolutions per minute at ratings up to 35,000 horsepower. They serve to step up the speed of high speed compressors, coupled to gas-turbine prime movers, that inject natural gas into wells to stimulate oil output. The gears are silver plated to prevent galling, which is the tearing apart of momentarily-welded surfaces caused by the lack of lubrication. At these speeds, under these pressures, and under the rugged conditions of the Alaska North Slope, galling may wear down gear faces rapidly. Silver provides the assurance of flawless, long-term performance.

The practical usefulness of silver is not limited to such conditions as these. For example, over 75 developments in silver for lubrication and bearings have been reported in The Silver Institute's "New Silver Technology". The July 1983 issue described new work of Dr. K.G. Budinski of Eastman Kodak Co., Rochester, N.Y. His work shows that the resistance of silver for metal-to-metal wear far surpasses that of all other commonly used bearing faces. Furthermore, in galling tests, metallic silver alone acts very much like a petroleum-type lubricant, smearing over the contact surfaces, preventing sticking or "welding". This can be extremely advantageous in industrial chemical processes where bearing surfaces cannot be lubricated with petroleum compounds which are incompatible with the chemical being processed.

Its superlative fatigue strength, combined with its high thermal conductivity, tensile strength and other properties, have made silver the ultimate choice wherever high power systems like turbine and diesel engines require flawless performance.

One plant, the Detroit Diesel Allison Division of General Motors, Indianapolis, IN, uses about one third of a metric ton of silver per month to silver-plate sleeve bearings, connecting rods, sliding contacts and other parts for diesel engines, turbochargers for railway locomotives and for gas turbines for aircraft. In some cases the silver is plated as a pure metal, in others as a low-lead silver alloy.

Lubricity of silver under high load and high temperatures has long been recognized. A new study conducted by Armco has shown that silver heavily electroplated onto hard stainless steel alloys can be effective in preventing galling or gouging regardless of the stress on the moving surfaces. Applications include stainless steel valves under high pressure and stainless steel bolts under high load conditions.

Studies by Armco of Middletown, OH, testing the galling resistance of silver-plated stainless steels, as reported in The Silver Institute's "New Silver Technology" for January, 1983, show that silver plate protected all sliding stainless steel alloy parts tested regardless of surface finish, composition, or hardness of the alloy. The tests showed the efficacy of metallic silver coatings for stainless steel valves under high stress conditions such as in power plants. Silver provided an adherent and durable bearing surface — "easily the best coating evaluated".

6.2.18 TONNAGE OXYGEN

One little known use of silver is in the important industrial field of "tonnage oxygen", crucial to some steel production and to the processing of chemicals.

Silver is the preferred material for cryogenic (low temperature) rupture seals. Silver mechanical seals join aluminum to stainless steel pipes. Large volumes of oxygen are shipped and handled safely and economically, using tough, precise, spark-resistant hardware.

6.2.19 NUCLEAR PHYSICS

Silver is used in nuclear physics work for the capture of slow neutrons, having a relatively high cross section for absorption of neutrons in the low-energy region. Alloys of silver and cadmium and of silver, cadmium and indium have been used for neutron absorption.

6.2.20 SILVER IN URANIUM AND PLUTONIUM IN NUCLEAR FUEL

The addition of silver to the uranium and plutonium of nuclear fuel improves the safety of the fuel and the nuclear plant.

6.2.21 RAINFALL PRODUCER

There have been improved cloud seeding developments for weather modification.

Silver can be prepared as crystals of silver iodide and seeded into a cool cloud to become the core of raindrops and snowflakes. To produce rain, about 1 ton of silver iodide is used — containing almost half a ton of silver, (54 parts iodide to 46 parts silver). It is also used for this purpose in the Soviet Union and France.

One thirtieth of an ounce of silver iodide will form ten trillion ice crystals, which every year enables parched Californian cities to wring billions of gallons of extra water from winter storms.

6.2.22 ALLOYS FOR BRAZING AND SOLDERING

Your family need not worry about the tubing that contains the cooling fluids in the refrigerator-freezer, or the heating coils in the automatic dishwasher, or the components of the single-control faucet for the sink, because their dependable connections are made secure by silver brazes.

Silver-bearing brazing metals are among the most widely used for these critical applications where reliable performance is mandatory, because the silver alloys wet almost all metals, are free-flowing and ductile and form strong and perfect seals.

Silver's extraordinary malleability, ductility and wetability makes it virtually indispensable in these applications.

In a dishwasher, the heating element is silver brazed to brass threaded connectors which attach the coil.

The washerless, single-control kitchen faucet has revolutionized the ease of using water in the kitchen, relying upon silver brazing to substantially increase its durability and performance.

Other bonding aids comprise a range of gold alloys, (gold-silver, gold-silver-copper, gold-nickel, gold-copper, gold-palladium etc.).

Such gold-silver alloy solders join turbine blades to rotors in jet engines in aircraft.

The Silver Institute and the Copper Development Association jointly sponsored the presentation of "Silver-Tin Solders for Large Diameter Copper Pipe," at the 14th International Soldering and Brazing Conference, at Philadephia, PA. The presentation covered the findings of an extensive study of the performance of soldered and brazed copper pipe over 4 inches in diameter conducted by the Copper Development Association.

The study was conducted to provide the installer with soldering and brazing techniques that will ensure a superior bond between sections of large diameter copper pipe. The new techniques that were discovered have now been published by the Copper Development Association in "Fabrication of Larger Diameter Tube and Fitting Systems," No. 404/3.

Silver-tin solders and silver brazes, because of their outstanding wetting of metals, extremely high strength and creep resistance and unmatched benignity to potable waters in contact with them, are the preferred bonding materials for hospital potable (drinkable) water systems, water cooling drinking fountains, ice-makers, etc. Silver brazes are especially preferred in refrigeration units where the expansion and contraction forces exert a high strain on the metal-to-metal joints and in water sprinkler systems where the integrity of bonds must withstand sharp temperature differences.

The use of silver as an excellent bonding material in brazing alloys and solders may possibly experience a greater decline in volume than any other use of silver. Annual usage in this area in 1982-83 was only about half of the 1971 figure and only one-third of its peak in 1973. Brazing alloys consumed 150 tons in the first half of 1982, up from the 65 tons recorded in the first half of 1981.

For welding, electrodeposited silver is used in joining metallurgically incompatible metals such as type 304 stainless steel and beryllium.

6.2.23 VIKING SPACE CRAFT TO MARS

An alloy containing more than 80 per cent silver developed by TRW Inc., Redondo Beach, CA, has solved the problem of bonding stainless steel to titanium to form the strong, light weight biology experiment equipment of the Viking space craft which travelled nearly half a billion miles to land on the planet Mars.

Conventional brazing and welding processes had not been effective in joining titanium to stainless steel, which have quite different metallurgical characteristics. Titanium, for example, has a very high melting point of over 3000° Fahrenheit, whereas stainless steel typically melts at 400° lower. However, these two materials, bonded together, are essential for the performance of the Viking biology experiment instruments which scooped up and meticulously analyzed samples of the planet's surface.

The silver-brazed Viking mini-laboratory made the first chemical report of signs of life on Mars. Whether our kind of life or not, it found a soil so exotic that it chemically mimics life processes on earth — to the great excitement of the world scientific community.

The development of this new silver bonding process is one of over 100 advances in silver brazing and soldering which The Silver Institute has summarized in the last few years for wider use in industry. More than 310 metric tons of silver were used for brazing and soldering in the U.S. in 1979 alone.

6.2.24 CATALYSTS

The current use of silver in catalysts in the chemical industry and pharmaceuticals is thought to be only about half of what it was in 1973. Silver is used in catalysts that are used to produce the ingredients of anti-freeze and the fibres of polyester dresses and suits.

However, there are recent quite new uses of catalysts for a variety of oxidation reactions.

High octane gasoline and synthetic rubber can be made by a silver-catalyzed dehydrogenation process for which Phillips Petroleum, OK, has been issued a U.S. Patent.

Silver is a key ingredient in a new and efficient catalyst to convert synthesis gas, a mixture of hydrogen and carbon monoxide, into methanol and ethanol, a useful automobile fuel.

Warm winter clothing includes a product of the magic of silver. How? Under controlled conditions, silver catalyzes the oxygen in the air. With a silver catalyst, air converts ethylene into ethylene oxide which is used to produce polyester fibers which — in turn — are used to manufacture millions of sweaters, coats, scarves and other fashionable and useful items of clothing.

Improved silver catalysts for making ethylene oxide, the base for billions of pounds of polyesters, have been developed by Imperial Chemical Industries Ltd. of London, BASF AG at Ludwigshafen and Mitsui Toatsu Chemicals Inc. of Tokyo.

A U.S. method of making benzene for chemical manufacture and high octane fuel with a silver-containing catalyst has been developed.

Du Pont now make formaldehyde for the production of millions of board feet of plywood with greater efficiency by the use of a new silver-gold catalyst.

The production of formaldehyde, a major building block for plastics and plywood production, has been markedly improved by the use of a catalyst consisting of metallic silver and lead.

For treating industrial effluent gases containing sulphide pollutants, silver is an essential element in a new catalyst developed by Institut Français du Petrole and described in a U.K. Patent.

Silvestre Sanchez Torres, Puebla, Mexico has been awarded a British Patent on a silver catalytic converter to greatly reduce the emission of harmful pollutants and noise in automotive engine exhausts.

Carbon monoxide in air is converted to harmless carbon dioxide by contact with silver containing yttrium, developed by the Faculty of Chemistry of the University of Sofia, Bulgaria.

Utilizing the catalytic power of silver, International Flavors & Fragrances Inc. of New York is manufacturing compounds that can fortify, modify and improve the flavour and aroma of foodstuffs, medicinal products, toothpastes, chewing gums and tobaccos.

MIRRORS

In the 16th Century, Petitjean of France discovered how to put a permanent reflective surface of silver on sheet glass, using silver nitrate. However, Justus von Liebig of Germany in 1853 discovered the modern process of "silvering" — the formation of a silver or other metallic coating on glass to give it the properties of a mirror. Most mirrors today have a silver surface under the glass. At least a billion people now alive must have looked at themselves in a silvered glass mirror at least once.

SILVER PLUS GLASS PLUS SUNLIGHT = ELECTRICITY

Gardner Mirror Corporation received in 1980 what it believed was the largest single mirror order every placed with any company anywhere in the world. This record transaction took place when Martin Marietta Aerospace and the United States Department of Energy selected Gardner Mirror to coat one million square feet of mirrors with pure metallic silver, to be used in two solar energy installations.

Approximately 26,000 mirrors, each 43 inches by 120 inches were used. Put another way, that is almost 23 acres of mirrors. The larger of the two solar installations is the Solar One power plant near Barstow, California. It was then the largest solar installation in the world and the first to convert sunlight into electricity which is fed into a commercial electric distribution system.

Solar One power plant, with its staggering array of silver coated mirrors, generates ten megawatts of electricity, which is enough electricity to satisfy the needs of a North American community of approximately 15,000 people. The second installation is in Almeria, Spain and generates one-half megawatt. It incorporates 93 heliostats, compared with the 1,818 heliostats needed by the California plant. Each heliostat is composed of 430 square feet of silver backed mirrors. Both installations were completed in 1981.

6.2.26 TELEVISION – MORE VIVID COLOUR PICTURES

A silver process is used to produce television picture tubes that transmit more vivid colour pictures.

6.2.27 HIGH PRESSURE FORMING OF HARD AND BRITTLE MATERIALS

Silver chloride is a perfect medium for high-pressure forming of hard and brittle materials. Titanium boride can be crushed into jet engine blades machine tools and high-speed drills when confined in a chamber with silver chloride at pressures of 116 tons per square inch. The resulting material exhibits unusual properties: increased ductility, increased workability and most remarkably, indications of superconductivity at room temperatures.

6.2.28 SILVER STRENGTHENS ALUMINUM AND LEAD

The addition of silver greatly strengthens aluminum alloy castings. For Underwater Structures, the strength of lead can be made to equal that of aluminum by incorporating silver-coated graphite or ceramic fibers into the lead matrix.

6.2.29 FASTER ROCKET MOTORS FROM SILVER

Japan has developed a process for embedding silver wire in solid propellant for faster rocket motors.

6.2.30 POLYMERS

For the production of acrylic type polymers, metallic silver plays a key role in a new process developed by Arco Chemical. Additions of silver nitrate to important polymers such as the polyamides, polyimides, polyethylenes, etc. raise their tensile modulus by 64 per cent to 467,000 pounds per square inch.

6.2.31 FRUIT AND FOOD

New developments use silver to inhibit the ripening of fruit. In England, control of infection in citrus trees by silver anodes has been developed.

The qualities of Harris Safety-Silv 1200 cadmium-free silver brazing alloy provide superb ductility, strength and corrosion resistance. Because of the non-toxic composition of this 56 per cent silver content alloy, it is ideal for use in food processing equipment where food comes into contact with the joint area, and for drinking water fountains and piping. In addition, the colour is bright silver, making an excellent colour match for stainless steel and silverware.

6.2.32 SILVER-COATED TEXTILE FIBRES

The deposit of a continuous fine coating of metallic silver on textile fibre is the industrial accomplishment of Sauquoit Industries, Scranton, PA. The Silver Institute consulted in the earlier research for this process and when Sauquoit industrialized it. The Silver Institute Letter, beginning with its February 1976 issue, assisted in bringing the products to international attention. The silver-coated fabrics found immediate use in antistatic carpeting to prevent annoying sparks and this aplication has been steadily increasing in hotels, hospitals, (see Medical), apartments and office buildings. More recently the silver-coated fibres are being increasingly used in antistatic filters for clean-room-operations in electronic and medicinal manufacturing firms to eliminate statically charged dust particles.

During winter, there is less humidity in the air and when a person walks on some carpets, the person accumulates static electricity. So when this person touches metal or another person — the static electricity is discharged as an electric shock. Now, these "shocking contacts" can be avoided by using a silver-coated nylon yarn, called X-Static, in the production of carpets. X-Static, made by Sauquoit gives carpets an intrinsic increase in their conductivity, reducing static build-up to a point that is far enough below the threshold of sensitivity that there is not enough voltage for people to be able to feel the static.

Another growing use for these fibres is that, in the form of textiles, they can be connected to the ground providing an electro-magnetic screen, fending off unwanted radiation for signals that might otherwise disrupt sensitive instruments or electronic equipment. Also, when prepared in the form of wallcoverings or garments, the silver-coated fabrics provide an effective screening device to protect individuals in areas where there is a high level of electromagnetic radiation.

Silver is used in improved fingerprint detection for law enforcement. When these silver coatings are applied to extremely fine fibres, they can be advantageously mixed in the pulps of security papers such as bonds, checks and currency paper. These measured small inclusions of detectable silver can be custom designed to provide reliable identifying "fingerprints" within the security papers.

6.2.33 DOLLAR BILLS

One paradox is that silver may be coming back into the regular U.S. currency, not as coins but as silver-metal threads in paper dollar bills. Perhaps Canada's too.

It is said that a completely new U.S. paper currency — in a different size and in different colours for the different denominations, like Canada's — but with silver metal "security" threads built into the paper — will be issued in 1985 or 1986. Such silver metal threads can be detected and the value of such bills counted by machines, at airports, etc. The British have incorporated a thin strip of tin metal in their pound notes for several decades. In the new 20-pound note, the security metal strip is "woven" into the paper so that in reflected light it presents a broken or dotted line. But held up the light, the strip looks continuous. The Japanese changed their larger currency notes to a new size and colour, with no change of value on October 31/November 1, 1984, but not apparently with the use of metallic threads. It is said that the U.S.$100 bill would be eliminated in such a new currency. It is equally true to say that observers such as Dr. Franz Pick forecast this possible U.S. action as long ago as May, 1973.

One rumour has it that the earliest release date for the alleged new U.S. paper currency dollar bills will be late 1985 at a rate of 90 new cents for one old dollar. Others close to the scene feel that the date will not be until 1986. We shall see.

One objective of the new "coded" currency would be to clip the wings of organised crime and drug traffic. Another would be to curtail the Underground Economy to some extent. Generally, such a paper currency switch should be bullish for silver and gold prices.

The U.S. Treasury has awarded a contract to American Banknote for U.S.$1.5 million to investigate materials and equipment needed to put holograms on paper money. A pilot press could produce $20 bills by mid-1986.

SILVER MAKES BEAUTIFUL MUSIC

Much of the beautiful music we hear comes from musical instruments that are made of 900 fine silver or are covered with a thick coat of pure silver. Flutes, trumpets, trombones, cornets and flugel horns are just a few of today's musical instruments that use the rich and pure tonal qualities of silver to enrich their melodious tones.

And when properly cared for, a silver or silver plated musical instrument gives off a deep, glowing lustre that rivals the richness of the tones it was created to produce. In the past, musicians had to polish their silver instruments, as frequently as every two weeks to preserve their soft, bright sheen. Now, by storing these instruments with 3M's new "Silver Protector Strips", the polished silver instruments shine brightly for up to twelve months and the strips can be used for any silver object.

6.2.35 WINTER SAFETY IN AUTOMOBILES

Silver makes a major contribution to winter automotive safety by helping drivers keep their rear view windows clear of ice and snow. Silver inks, produced by Engelhard Industries, NJ and Canada, are used by automobile manufacturers to make almost invisible silver threads in the rear window glass which are connected to the car battery. When the driver turns on a switch, electricity runs through the silver, heats the glass and keeps it clear of ice, snow or fogging. And as is so frequently the case, it takes very little silver to accomplish its important task — only about 6 grams of silver, (6 g.), is needed to equip a standard sized car with this excellent defroster.

There is further hope that silver will eventually aid millions of motorists in clearing their windshields of ice and snow. The imaginative research and development personnel of Acheson Industries, Huron, MI, have developed a patented, fast, flexible and durable heating element for windshield wiper blades which melts snow and ice. These heating elements are 91 per cent metallic silver compound and 9 per cent fluoro-rubber binder incorporated in a strip of glass fibres. The composition is electrically conductive, directly solderable like a metal, while remaining flexible like rubber.

Other technical experts are developing ways to use silver to protect concrete bridges against the corrosive ravages caused by the salt used to remove winter's ice and snow from the roadways. According to the Chemical Engineering Department of the University of Oklahoma, Norman, OK, the chloride ions of the salt penetrate the concrete and react with the steel reinforcements (rebars) embedded in the concrete bridges unless the steel is adequately protected. An effective way to do this is to connect the negative terminal of a source of d.c. current to the steel rebars and the positive terminal to a silver-silver chloride reference electrode permanently embedded in another part of the concrete. Metallic zinc has conventionally been used for reference electrodes, but it now appears that superior long term performance can be obtained with the more rugged, more stable silver-silver chloride reference electrodes.

6.2.36 TELEPHONES

Silver contact strips are installed in the newest telephones.

6.2.37 LIPSTICK CASES

Lipstick cases are often silver plated by the use of silver salts.

6.2.38 TURBINE ENGINES

The compressor section of a jet turbine engine is typically constructed with a 56 per cent silver alloy for increased strength and corrosion resistance.

6.2.39 CONVERTING CARBON MONOXIDE TO HARMLESS CARBON DIOXIDE

Silver-bearing yttrium to convert carbon monoxide to harmless carbon dioxide.

6.2.40 CONVERTING OZONE IN JET AIRCRAFT TO HARMLESS OXYGEN

Silver-coated mesh to convert ozone entering jet aircraft from the upper atmosphere into harmless oxygen.

6.2.41 SOUND TRACKS

Silver halide-treated sound tracks are a new development.

6.2.42 FURTHER INNOVATIONS

New types in a new generation of silver-containing batteries for aerospace and perhaps other applications.

6.2.43 INCENTIVES AND RECOGNITION AWARDS IN SOLID SILVER

Many firms in the U.S.A. and Canada find that they can increase productivity in their plants by offering awards for suggestions or outstanding performance in solid silver and in gold.

Silver used in "coins, medallions and commemorative objects in 1983 showed an increase in the U.S. of 37.3 metric tons over 1982", according to the U.S. Bureau of Mines.

INGOTS OF SOLID SILVER AS INCENTIVE

Gleaming pure silver awards act as a powerful incentive in industry and commerce.

These beautiful silver bars can be offered in the form of accessories, such as pendants and key rings, or a medallions or other forms, Sterling silver is a precious metal and people respond to that.

Company offering Solid Silver Incentives	Incentive	Manufacturer
University of Waterloo Ontario, Canada	2.5 troy ounce (77/73 gram) pure silver medallions	Johnson Matthey, Ltd. Toronto and Brampton, Ontario, Canada
University of Alberta, Canada (awards for deserving students in the Faculty of Science)	1.5 troy ounce (46.6 grams) pure silver medallions	Johnson Matthey, Ltd. Toronto and Brampton, Ontario, Canada
Sklar Pepler furniture company, Canada (in an incentive program that boosted the firm's share of the market to 68 per cent)	Half-Kilogram (500 g.) — pure silver ingots	various
Coca-Cola, Texas; incentive for its distributors	2 troy ounce (62.2 g.) pure silver so-called "Texas Nickel"	various
Many Companies, as incentive awards	Mirror polish 100 troy ounce (3,110 g.) ingots. n.b. — Silver has been around U.S.$6 an ounce recently	Johnson Matthey, Ltd. Toronto and Brampton, Ontario, Canada
Washington Federal Savings and Loan	4 gram (g.) pure silver pendants	various
Washington Federal Savings and Loan	4 gram (g.) pure silver key rings	various
Washington Federal Savings and Loan	Many other silver pendants etc.	various
Washington Federal Savings and Loan	Many other silver pendants etc.	various
General Foods, U.S. and Canada as a sales incentive	.999 (99.9 per pure) silver medallions	Texas Mint, Dallas
Many Companies, as incentive awards	"American Prospector" .999 (99.9 per cent) pure silver medallion	Engelhard Corporation, U.S. and Canada
Bank of Nova Scotia, Toronto, Ontario, Canada (recognition award for employees of 45 to 50 years service)	Magnificent silver tea and coffee service	various
Other companies in the U.S. and Canada offering silver and gold awards as incentives include: Northern Natural Gas, IBM, Bell Telephone Yellow Pages, Estee Lauder, Mobil Oil, Chase Manhattan Bank, Texas American Bank of Dallas, Renault, Blue Shield, Oldsmobile, Bank of America, Yamaha, Sony etc.	A variety of solid silver and gold incentives	various

Some of the Companies offering Solid Silver Incentives	Incentive	Manufacturer
Many Savings and Loan Institutions in U.S. and Canada; incentive awards to those who open new savings accounts	Sterling Silver bracelets, chains necklaces and ingot jewellery	1) Catamore Company, East Providence, Rhode Island 2) Rembrandt Jewellery Manufacturing, Scarborough, Ontario, Canada
Many companies	Other solid silver items as incentives, lapel pins, investment ingots, medallions, sterling silver buckles, trophies	1) Royal Canadian Mint Ottawa, Ontario, Canada 2) Handy & Harman, New York 3) Sunshine Mining Co., Dallas, Texas. 4) Engelhard, U.S.A. and Canada
Ranchers Exploration and Development Corporation, Albuquerque, New Mexico, (now part of Hecla Mining Company), — paid out as dividends from its Escalante silver mine in Utah	Silver Bars	Johnson Matthey Ltd., Toronto and Brampton, Ontario, Canada
Kraft Foods, U.S. and Canada Kraft Merit Award, dating from 1933, recognizing unusual initiatives above and beyond normal job responsibilities. More than 3,000 employees have won it.	Sterling Silver ring with a jade stone	Balfour, Attleboro, MA
Carrier Corporation, U.S. and Canada — heat pump sales promotion program	One ounce pure silver "coins"	The Metal Arts Company, New York
Sunshine Mining Company — employee incentive award — used by many companies	Pure .999 silver bullion "coin", 1 troy ounce	The Metal Arts Company
Many companies, as incentive awards	Small silver bars	Johnson Matthey Ltd., Toronto and Brampton, Ontario, Canada
Engelhard Corporation, U.S. and Canada — to retiring employees	Sterling silver Retirement Bowl	Engelhard Corporation, U.S.A. and Canada
John Hancock Insurance Company	"President Award", a heavy hand-hammered solid sterling silver bowl, 22 inches in diameter, mounted on several high sterling silver columns	Balfour

Some of the Companies offering Solid Silver Incentives	Incentive	Manufacturer
Various Companies	.999 pure silver 5 gram bars	Engelhard Corporation, U.S.A. and Canada
Many Companies	.999 pure silver 1 gram bars	Johnson Matthey, Toronto and Brampton, Ontario, Canada
Many Companies	Sterling Vermeil (a coating of pure gold of at least 120 micro-inches on solid sterling silver) — various items. It looks like gold, but it is virtually all solid silver	various

Japanese companies reward their long service employees with gold trophies, silverware, etc.

6.2.44 REFRIGERATION

Between 1965 and 1970, consumption of silver in refrigeration grew by 40 per cent, from 311 metric tons to about 435 metric tons.

6.2.44.1 EXPLOSIVES

Silver goes into detonators for the explosives industry.

6.2.45 CUTTING DOWN ON THE USE OF SILVER

The efforts now under way to reduce the use of silver in the industrial sector are detailed in a March, 1982 study on the price responsiveness of secondary silver prepared for the U.S. Department of Commerce by Economic Consulting Services Inc.

SUBSTITUTION OF SILVER FROM OR BY OTHER MATERIALS

Switch to Silver from Gold

There has been a switch from gold to silver connections in computers, where expensive metals, including gold and platinum, have had to be used in the past to make reliable electrical connections.

Potential substitutes for gold (apart from price) are palladium and silver in electrical uses where substitution has been the most successful; transition metals in other uses.

The electronics industry is steadily increasing its consumption of silver, boosting the long range outlook for silver.

Seven metric tons of scrapped computers usually yield one metric ton of gold-bearing components, so in the next few years a somewhat comparable amount of silver should become available from that form of scrap.

Johnson Matthey Chemicals introduced in 1984 a silver-based adhesive for the silicon chip industry which threatens the market for existing gold-based adhesives. The new product, Au-Sub, has already been a success in the U.S. and Far Eastern markets.

JM officials estimate that Au-Sub will require about 6 metric tons of silver a year, replacing adhesives which use up to 12 metric tons of gold a year.

6.2.46 MONETARY ROLE OF SILVER

THE ROLE OF SILVER AND GOLD — AS MONEY

Silver and gold are, have been and probably always will be the ultimate store of wealth. They have been extremely valuable for 6,000 years at least. For thousands of years, silver and gold have been used for coinage and trade and more recently as backing for paper currency. The pro and con arguments on silver and gold's monetary role will probably continue until Domesday. The main argument in support is that ultimately silver and gold serve best as a measure for final settlement.

To many people, (particularly in Western Europe, Southeastern Europe and the Middle and Far East), silver and gold are "hard money" and far superior to printed paper called dollar bills, pound notes, franc notes, pesos etc. For centuries, the standard of value par excellence has been gold and silver.

SILVER AND GOLD NEED NOBODY'S SIGNATURE TO MAKE THEM VALUABLE. This needs to be emphasized over and over again.

VALUABLE SILVER METAL CANNOT BE CREATED OUT OF THE BLUE, LIKE THE PRINTING OF PAPER MONEY.

In the age-old conflict between silver and gold as money and paper or credit-debt as money, history shows that both silver and gold have been the long term winners. To give only one example, for about 800 years the Byzantine Empire's gold coin, the "bezant", was the solid monetary basis for the known world's trade. However, when Alexius Comnenus reduced the gold content, the Byzantine Empire declined and was eventually engulfed by the Turks. Gold then became the unit of the Renaissance in Western European countries, while the British remained with silver.

Gold remains quite simply the "numeraire" or reference point or measuring stick for all man-made currencies.

Silver and gold are universally accepted as value. Silver and gold are the one universally accepted currency, in effect. In the last resort, gold and silver are always money.

The Austrian economist, Schumpeter, has said that THE MODERN MIND DISLIKES SILVER AND GOLD BECAUSE THEY BLURT OUT UNPLEASANT TRUTHS.

They differ from other commodities because they are to many people still primarily monetary metals and only secondarily a raw material for industry and the arts.

The U.S. paper dollar is now worth 3.4 cents of its 1940 constant dollar value. The Canadian 1984 paper dollar is worth even less, say 2.6 cents expressed in U.S. currency. However, pre-1965 U.S. silver coins (90 per cent silver) and the old Canadian coins (80 per cent silver) that survive are now worth far more than their 1940 constant dollar value. Yet the typical U.S. and Canadian citizen still thinks of his paper dollar as "real money".

The French, victims of many wars against their rich country, reputedly have 5,000 tons of gold squirrelled away privately — much of it in the form of "Napoleon" gold coins. French paper money has lost its value so many times.

The history of silver and gold as a medium of exchange followed closely on the barter exchange system. In 550 B.C., Croesus, King of Lydia in Asia Minor, ordered the world's first known gold and silver coins to be struck. Gold and silver had been universally accepted in trade for all other goods or commodities for thousand of years — long before coinage, of course.

6.2.47 FUTURE GROWTH IN THE WORLD DEMAND FOR SILVER AND "OUTLOOK"

The Future to the year 2000.

> "All of us are fascinated by the future, because that is where we will live the rest of our lives."
>
> — Criswell.

Professor J. O'Toole of the Graduate School of Business of the University of California, Los Angeles, has said:

> "We futurists know only one thing for certain about the future: It cannot be predicted." (O'Toole's Law)
>
> "Never prophesy, especially about the future."
>
> — S. Goldwyn.

By the year 2000, there will be up to 2 billion *more* people on the earth, (mainly in Asia and Latin America, areas which historically have always had a particular yearning for silver and gold), than in 1980.

EVEN IF A MINUTE AMOUNT OF SILVER, SAY 1 GRAM (1 g.), WERE USED BY EACH OF THE 2 BILLION EXTRA PERSONS ANNUALLY, THAT WOULD AMOUNT TO 2,000 METRIC TONS OF SILVER A YEAR. (Compare total Western world mine output of 9,500 metric tons of silver in 1983). Of course, the actual forecast is that the extra billions of people will directly or indirectly cause the use of MUCH MORE THAN 1 g. of silver per person.

The world total will then be over 6 billion people in the year 2000. (Compare the world total of 2 billion in 1925). One estimate of world population in 2030 in 10 billion — compared to 4 billion now.

By the year 2000, 15 years from now, the world's largest cities will make a size list radically different to 1925. Most of them will be even larger in 2025. They are mainly in warm weather countries. Paris and London, which will be and 17th and 18th in size, are further from the Equator than the others in the list. We do not know the actual projections of Moscow and other cities of the Eastern European centrally planned countries, but Moscow is projected by the U.N. as 10 to 15 million by 2025, which is a pretty wide variation.

	2000	2025	
1.	31 million	31 million	Mexico City, Mexico, North America (Spanish speaking)

Mexico City became the world's largest city in 1984 with 17 million people. It took London 130 years to grow from 1 million people to 8 million. Mexico City did it in only 30 years from 1940 to 1970. In the last 15 years it has doubled again to 17 million and may double once more by 2000.

	2000	2025	
2.	26 million	30 million	Sao Paulo, Brazil, South America (Portuguese speaking
3.	24 million	24 million	Tokyo-Yokohama, Japan (the world's largest city area in 1984)
4.	23 million	23 million	New York-NE New Jersey, U.S.A., North America
5.	23 million	23 million	Shanghai, China
6.	20 million	20 million	Beijing (Peking), China
7.	19 million	20 million	Rio de Janeiro, Brazil, South America (Portuguese speaking)
8.	17 million	20-30 million	Bombay, India
9.	17 million	20-30 million	Calcutta, India

	2000	**2025**	
10.	17 million	20-30 million	Djakarta, Indonesia
11.	14 million	n.a.	Seoul, South Korea
12.	13 million	20-30 million	Cairo-Giza-Imbaba, Egypt, Africa
13.	12 million	n.a.	Manila, Philippines
14.	12 million	15 million	Buenos Aires, Argentina, South America
15.	12 million	n.a.	Bogota, Colombia, South America
16.	n.a.	10-15 million	Moscow, Soviet Union
17.	11 million	about 11 million	Paris, France
18.	n.a.	about 10 million	London, U.K.

Of the first 15 above, 5 are in Latin America. Further, 4 in the list are Spanish-speaking and 2 are Portuguese-speaking. 8 are in Asia. Only 1 city is in Africa and only 2 in Western Europe. English is the main commercial language in less than half a dozen.

Brazil, China and India will each have two such cities.

With cities of such enormous populations and with 50 per cent more people on earth than in 1980, major problems will develop by 2000.

India's huge total population will double in the next 45 years and that of Bangladesh will have nearly tripled.

Some U.S. cities and conurbations should grow at a high rate in the next few years.

	1980 Population	**1990 Population (projected)**	**Percentage Increase**
Fort Lauderdale/Hollywood, Florida	980,000	1.55 million	58.2 per cent
Orlando, Florida	657,000	951,000	44.7 per cent
Phoenix, Arizona	1.38 million	1.96 million	42.2 per cent
Tampa/St. Petersburg, Florida	1.51 million	2.097 million	38.3 per cent
Anaheim/Santa Ana/Garden Grove, California	1.97 million	2.73 million	38.6 per cent
Houston, Texas	2.74 million	3.75 million	37.0 per cent

n.b. 1) These cities are all in the warm southern belt.

2) 3 of the 6 are in Florida

With world silver and gold mine output likely to remain quite limited in total — even at much higher prices than 1980 — THE DESIRE FOR GOLD AND SILVER WILL REMAIN AND SO MORE AND MORE PEOPLE WILL WANT TO POSSESS SOME OF IT.

Of course, the higher the prices go, the more likely it is that more marginal deposits will be mined, particularly in economically and politically stable countries like Canada.

Gold could also be extracted from seawater, if the world price goes high enough. The Russians might do this first but that is probably decades ahead.

The most likely additional forecast is that in a large and growing number of countries, private ownership of gold bullion and perhaps gold coins will be forbidden or closely controlled by governments, as it is in the Soviet Union, Eastern Europe etc. currently.

This retrograde step would tend to inhibit the opening up of some marginal gold mines in free countries.

In 1980, the Soviet Union had 50 million more people to feed than in the early 1960's. After 68 years of a centrally planned economy, it cannot feed all of its population now without very large imports of grain. This has been obtained year after year by imports from the U.S., Canada, Australia, Argentina, etc. In the 20 years, 1980 through the year 2000, the Soviet population will presumably increase by some 50 million and therefore, barring some miracle in domestic grain output, even larger amounts of feed grains will have to be imported, (to be paid for with increasing exports of gold etc. to the West). Once again, the Soviet grain crop fell far below target in 1984, an output of only 170 million tons compared to the planned 238 to 243 million metric tons a year under the 5-year Plan, 1981-85. Therefore, soviet mine output of gold and other tradeable commodities will have to be increased to help provide this. Basically, this is bearish for the world gold price and therefore silver, but where will the Soviets obtain that amount of physical gold year after year? They are also likely to remain not only basically net importers of silver but in fact importers of much larger amounts of silver.

The U.S. is letting the USSR purchase more grain than usual, starting October, 1, 1984, up to 22 million metric tons of wheat and/or corn, an increase of about 10 million tons over the prior years. The Soviet Union is committed to buying at least 35 million metric tons of grain a year under half a dozen agreements with various countries. This large purchase volume usually has a bearish effect on the gold price and therefore silver's too.

It is possible that China too may have to increase its grain imports to feed the growing population — to be paid for by exports to the West of gold etc. — but China is in the process of becoming a large importer of silver, which reduces the amount of their limited availability of hard currency for the purchase of grains etc. from the West.

Major Importers of Cereal Grain*

(million metric tons, July 1, 1980-June 30, 1981 estimated)

Soviet Union	32
Eastern Europe	12
Japan	24
North Africa/Middle East	23
India and China, 1982	16
China	14
South Africa, 1984	5
Italy	7
Brazil	6
Poland	6
Egypt	6
Mexico, 1981	1.2
Spain	6
U.K. (see Exporters below)	6
West Germany (see Exporters below)	5

* wheat, sorghum, corn, rice, barley, millet, rye, oats and mixed.

At end-1980, the world's supply of cereals was the tightest since 1974, relative to demand.

In 1984, China, India and Mexico had such good grain harvests that they can now export.

The Soviet Union imported more grain in 1984 than at any time since 1973.

80 per cent of the wheat that is traded internationally (part of about 190 million metric tons of grain in all), during September each year is har-

vested in 3 areas of the northern hemisphere, Canada, the U.S. and Western Europe. In 1984, a sizeable 159 million metric tons of wheat was be reaped by the farmers of the rich north — about 69 million tons in the U.S., Canada less than 21 million and Western Europe some 65 million tons. In the southern hemisphere, Australia produced 22 million tons and Argentina 21 million tons.

Grain imports must increase in Africa. An estimated 26 African nations had near-famine conditions in 1983. More food aid to Africa is planned. The new silver-based methods for reducing the deadly African sleeping sickness will result in keeping tens of thousands or perhaps hundreds of thousands more people alive in Africa and that will clearly worsen the food situation.

South Africa had to import grain in 1981, the first time in 10 years. Drought reduced the domestic crop. Imports were around 200,000 metric tons of wheat. The current 1984 season's wheat crop may be only 1.5 million tons — down from 2 million tons in the previous year.

South Africa will have to import grain yet again in 1984 — about 5 million tons — because of another drought. This drains South Africa of some hard-to-get foreign currency at a time when the South African Rand is now worth only half its 1981 value in U.S. funds. Every dollar the country can get is now worth 2 domestic Rands, compared to one in 1981, but that is certainly a mixed blessing.

Major Exporters of Grain*

(million metric tons, July 1, 1980 — June 30, 1981 estimated)

U.S.A.	113
Canada	17
France	17
Australia/New Zealand	14
Argentina	14
South Africa	3
Thailand	3
West Germany (see importers above)	2
U.K. (see importers above)	3
Romania	2

* Wheat, sorgum, corn, rice, barley, millet, rye, oats and feed grains

Australia's exports of grain will probably exceed 15 million metric tons in 1984/85, compared to 14.1 million tons exported in the crop year ended September 30, 1984.

World's Largest Grain Producers

(excluding rice and soybeans)

	(millions of metric tons)
U.S.A.	252
U.S.S.R.	160 (180 in 1984 estimated)
China	130
France	40
Canada	37
India	37
Australia	37
Argentina	26
West Germany	24
Brazil	25
Others	balance
	1,450

The Soviet Union is the world's leading producer of wheat, barley, rye, flax, potatoes and sugar beet. It averaged an output of only 160 million metric tons of grain a year in the period 1964 through 1970.

U.S. agricultural subsidies to agriculture totalled U.S.$19 billion in 1983 and Western Europe's E.E.C. subsidies to farmers came to U.S.$15.5 billion.

6.2.48 HALLMARKS AND STANDARDS

HALLMARKING — U.K. AND IRELAND

It is possible to date a silver object made in the U.K. or Ireland with considerable accuracy because of the hallmarking laws in the British Isles dating from 1238 A.D. in the reign of King Henry III. All silver, gold and platinum articles are required by law to be hallmarked as genuine before they are offered for sale. However, certain silver articles are exempted from hallmarking under a 1973 U.K. Act, i.e. silver plate, U.K. coins and articles for medical, dental, veterinary, scientific or industrial applications.

Hallmarks comprise a line of separate punchmarks, normally four, on a U.K. fabricated precious metal object which, by an authorized code sequence, tells us the place, the year and the maker of that piece. A leopard's head, the first punchmark, if done in London, guarantees that the object is of silver of the prescribed standard. There follows the mark of the maker; then that of the letter of the alphabet indicating the year of manufacture, a mark instituted in 1363.

The place where a silver object containing 92.5 per cent silver was made, whether a city or a country, is shown by a lion passant for England, (from 1544), a harp for Dublin, a lion rampant for Edinburgh etc., in the case of the British Isles.

Continental Europe has a spread eagle for Germany, a hand for Antwerp and ornate capital letters and a crown or fleur de lys for France.

In the U.K., gold articles are marked with a crown followed by the millesimal figure for the standard of purity or fineness, i.e. 916 for 22 carat, 750 for 18 carat etc. Absolute purity would be 1000 fine or 24 carat, but that would be too soft for normal use.

In the U.K., it is illegal to offer for sale as "silver" any goods or objects containing less than 92.5 per cent silver, i.e. less than the sterling silver standard.

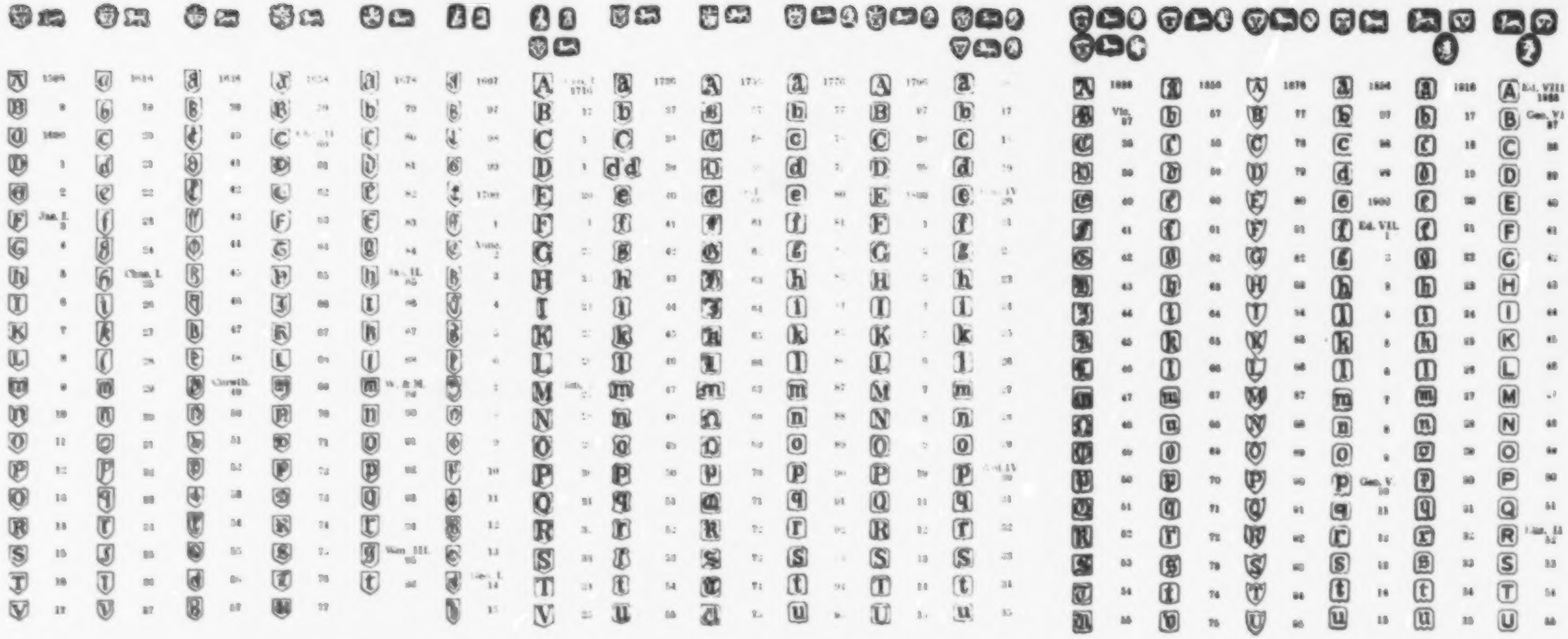
CANADA

In Canada, the federal Precious Metals Marking Act applies. The Canadian market for jewellery and silverware was $616 million in 1977. The value of illegal precious metals smuggled into Canada each year is estimated at between $200 million and $400 million. There is a 10 per cent Federal excise tax on imported precious metals, as well as 25 per cent Federal import duties on semi-finished products and a 9 per cent Federal sales tax. The strong incentive to avoid paying these millions of dollars of taxes and duties makes smuggling of jewellery highly profitable. The Canadian Jewellery Association estimated that the Federal government loses $98 million in revenue for every $100 million in such illegal goods coming into Canada.

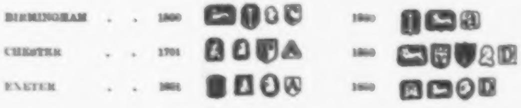
Since Canada is one of the top three mine producers of gold, platinum and silver in the world, there is an element of irony in all this. As a statistical average, it might be argued that a certain proportion of the gold, platinum or silver content of the jewellery coming into Canada could be Canadian-mined precious metal originally exported in primary form which is coming back to Canada as jewellery.

The CJA urged the dropping of at least the 10 per cent Federal excise tax — thereby reducing the incentive to smuggle and increasing the gross amount of tax revenue collected. However, it appears that the Federal Government in Ottawa needs every penny it can get from taxation.

THE LONDON SILVER MARKS

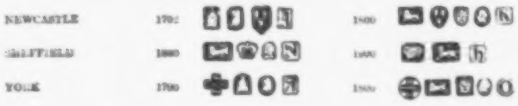

1598
1618
1638
1658
1678
1697
1716
1736
1756
1776
1796
1816
1836
1856
1876
1896
1916
1936
Jas. I.
Chas. I.
Cromwell
Jas. II.
W. & M.
Wm. III.
Anne
Geo. I.
Geo. II.
Geo. III.
Geo. IV.
Wm. IV.
Vic.
Ed. VII.
Geo. V.
Ed. VIII
Geo. VI
Eliz. II

PROVINCIAL SILVER MARKS

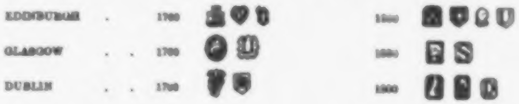

BIRMINGHAM . . 1800
1900
CHESTER . . 1701
1900
EXETER . . 1801
1900

See also Hall-mark, Lion, illustration.

PROVINCIAL SILVER MARKS


NEWCASTLE 1702
1800
SHEFFIELD 1800
1900
YORK 1700
1800

SCOTTISH AND IRISH SILVER MARKS


EDINBURGH . 1700
1900
GLASGOW . . 1700
1900
DUBLIN . . 1700
1900

Chapter 7 Silver — World Supply and Demand Balance Picture

THE ENVIRONMENT THAT SILVER NOW FINDS ITSELF IN AND THE FASCINATING FUTURE OF SILVER

Let us describe the dramatic changes I expect to occur with regard to silver consumption, supplies and price between now and the year 2000. The whole metals scene is undergoing great change. If you can believe it, by the year 2020, the world's annual appetite for certain minerals may be way above the current level.

There will be available from mines about 60 per cent of the total estimated demand for silver in the world through the year 2000.

For most of the time during the last few decades, total free world demand for silver has exceeded the amount of newly mined silver, which itself was very high in 1983, compared to many previous years.

REMEMBER, WE CAN NEVER COME UP WITH THE FUNDAMENTALS OF SILVER. THE DATA WE STUDY ON SUPPLY AND DEMAND AND STOCKS AND SO ON ARE ALWAYS UNSATISFACTORY, WITH FLAWS LARGE ENOUGH TO DISTORT OUR CONCLUSIONS.

However, as Freud said, "there is no contradiction in opposites". From this it follows logically that important decisions are made in inhospitable conditions; that major battles are fought over uninhabitable territory; that temporary solutions are permanent and permanent solutions are temporary. Under this rule one is no longer confused by the fact that many peace demonstrations are violent.

It is however beyond argument that world mine production of silver cannot and probably never can supply the full needs of the silver-consuming industrial sector in the world. Recoveries from scrap and other secondary sources and drawdowns from stocks have made up the difference in the last few decades, but the accumulated stock supplies have dwindled somewhat dramatically.

Silver appears to oscillate between periods of under-supply and over-supply. From late 1979 onwards, silver has been in continuous total oversupply in the Western World. Fortunately, a large part of this recent surplus has been absorbed by the North American private investor, who, as a type, however, is still basically wary about silver.

The high prices of later 1979 and early 1980 stimulated searches for ways and means of using less silver in industry, a few of which were successful, but meanwhile, a swarm of completely new uses for silver have been developed.

7.1 WORLD SUPPLY AND DEMAND – SILVER

(metric tons)

Supply	**1978**	**1979**	**1980**	**1981**	**1982**	**1983 est.**	**1984 est.**	**1985 projected**
Output (Western)								
Mine output of Western countries-primary silver	8,250	8,400	7,950	8,808	9,166	9,580	9,550	9,600
Secondary (Western) total	5,300	5,692	9,000	5,599	4,050	5,650	5,080 (6,000 -Credit Suisse)	3,200 -3,400
From (to) Communist Bloc	218	450	400	250	(250)	30	150	150
Total Western World Principal Supply	13,868	14,542	17,536	14,696	13,000	15,260	14,780	12,950 -13,450
Imports from India and Southeast Asia	1,400	1,150	1,369	1,306	1,151	1,711	1,200	1,250
Sales by Governments, net (including drawdowns for coinage)	250	100	155	125	345	500	150	150
Overall Silver Supply	15,518	15,792	19,060	16,127	14,226	17,471	16,130 (16,298 -Credit Suisse)	14,350 -14,850

CONSUMPTION IN THE WESTERN WORLD

Industrial	13,561	13,950	11,300	10,950	11,350	11,150	11,500 -11,750 (12,650 -Credit Suisse)	12,250 -12,750
Coinage	1,213	850	450	310	398	578	900	750
Total Demand (excluding exports to the Soviet Bloc)	14,774	14,800	11,750	11,260	11,748	11,728	12,400 -12,700	13,000 -13,500
Net Exports to Communist Bloc countries	n.a.	n.a.	n.a.	0	250	400 to 600	n.a.	n.a.
U.S. Surplus or (Deficit) (included in other categories)	n.a.	n.a.	n.a.	(732)	168	1,191	n.a.	n.a.
U.S. Government Stocks, end-year	n.a.	n.a.	n.a.	5,600	5,475	5,355	n.a.	n.a.
Worldwide Government Stocks	n.a.	n.a.	n.a.	10.265	10,140	10,020	n.a.	n.a.
Estimated Increase in Worldwide Hoards, Private and Commercial (M.A.&.O.)	(1,700)	(350)	5,500	2,900	2,050	2,500	1,000	1,350

Sources: T.P. Mohide, Ontario Ministry of Natural Resources, Mineral Resources Branch; J. Aron/Goldman Sachs; Conti-Commodity; Metals Analysis and Outlook; Economist; Samuel Montagu; Rudolf Wolff; Handy and Harman; Shearson/American Express; Credit Suisse; Mining Annual Review.

n.b. The "data" currently available must be considered unsatisfactory with flaws large enough to distort conclusions.

Silver Supply, including secondary, in prior years was estimated as follows:

(metric tons)

1969	1970	1971	1972	1973	1974	1975	1976
15,860	13,370	11,820	11,500	14,310	13,220	14,000	14,740

We are, to some extent, going through a relentless and accelerating revolution in the world with regard to natural resources, whether they are renewable, such as fish, grains and oilseeds, or non-renewable such as minerals and metals.

In North America particularly, we are beginning the process of ceasing to be the managers of accumulated commodity surpluses, reserves or stockpiles of resources such as silver, copper, cobalt, nickel, platinum, palladium, tin, manganese, chromium, etc. Partly because of the high cost of money, most inventories are still shrinking, except for certain remaining U.S. government stockpile metals and other countries' Central Bank metals which are designed for sell-off.

We are in general however, in the process of becoming managers of shortages — overall world shortages of, (or inability to pay for), grains, oilseeds, proteins, fish, aluminum, etc., for which there has been a dramatic rise in demand in the last two decades or a decline in supplies, or for which a rise in demand is imminent, with inadequate supplies indicated.

The permanence of a silver shortfall in newly mined supplies versus demand, (with constant dollar prices far higher than in the 1970's), has forced consideration of a number of attempts at technical substitution, partly reflecting such high price effects, even though there are large surface stocks of refined silver.

Governments of most countries that produce natural resources are saying in various ways that they intend to try to get a greater economic return for them, particularly when they are non-renewable and commodity prices are expected to be high. Incidentally, under the Canadian Constitution, the governments of the provinces have the control over natural resources, not the central government, with the exception of uranium.

Production of metals from mines for world markets is no longer characterized and dominated by private ownership. There is currently an increasing proportion of metal mines in the world owned or controlled by governments or their agencies.

Many mining companies are at fault and have damaged themselves in having failed to do enough exploration in safe countries such as Canada to replace ore reserves.

Silver will not be an exception in this trend to economic nationalism. Natural resources could eventually give Canada and other resource producing countries a stronger bargaining position internationally, such as in G.A.T.T. However, success might remain elusive. Harald Malgrem, the Washington trade expert, points out that Canada's great strength, resources, (other than gold, silver, platinum etc.), is losing value and most resources prices will remain depressed, in constant dollar terms, for as far out as the eye can see.

Under pressure from many quarters, the attempt to get this better return has taken various forms, including:

1) the taking over from foreign interests of control over production and/or disposition of domestic natural resources;

2) increased taxation on the gross value or on the profits made by those firms extracting the mineral resources, in the last decade or so such as in Canada, Australia and other countries;

3) withdrawal of special privileges for mines such as 3-year tax-free periods;

4) outright or partial confiscation of the mines by the state, usually without compensation. In quite a number of countries, particularly in Africa and South America, newly mined metals are either the only major product or a very important product comprising or supporting the national economy in such mono-commodity countries. When control by the state is introduced, mine output of metals is

not reduced when international metal prices are low, (as is usual in free enterprise), but is maintained or even increased, so desperate is their need for income. This depresses the world prices for metals.

The developing countries are pumping out their mineral resources as fast as they can to help pay off their external debts.

5) the inter-governmental tactical grouping of countries with similar primary commodity output, such as copper, (CIPEC) or oil, (OPEC), aimed at obtaining higher commodity prices from the consumers.

It would be unwise to underestimate the extent to which these efforts will be effective. This new resource climate is here to stay.

More caution in initiating large new mine projects in unstable countries is naturally indicated and this eventually will help to rationalize newly mined metal supply.

More government intervention in related areas is indicated even in the U.S.A. and Canada — witness the U.S. federal laws on the environment and on supervision of exchange trading in non-regulated "international" commodities, including metals such as silver — which further complicates the free operation of the economic options.

Personal holdings of gold and silver may be in jeopardy. To take one country as an example, the import of gold into France in bars, ingots or coins, (i.e. as units of exchange, in the French view), is prohibited, except with prior permission from the Banque de France. Even personal objects containing gold, if their weight exceeds 500 g (half a kilo, or about 1.1 pounds), must be declared at French Customs. This sort of control may come in the U.S. or Canada, eventually.

There is already a law on the U.S. statute books, the Emergency Powers Act, which authorizes the confiscation of gold (and silver?) owned by U.S. residents and citizens.

Under new Internal Revenue Service tax regulations in the U.S., the proposed mandatory reporting of privately held gold and silver coins includes all coins whose value is less than 15 per cent higher than the spot price of gold or silver.

The overall natural resources revolution is being caused by major world demand factors, such as:

1) The major sources of commodities, particularly minerals such as silver, are located in the less developed world and in Canada and Australia, (but in the case of silver the U.S.A. is an important mine producer also).

2) **World Population**

	1950	1960	1971	Area Sq.km.	Population Density Per sq.Km.
	(millions)				
World Total	2,486	2,982	3,706	135.8	27
Europe, excl. Turkey and USSR	392	425	466	4.9	94
Asia, incl. Turkey, excl. USSR.	1,305	1,645	2,104	27.5	76
North and South America, incl. Hawaii	328	412	522	42.1	12
Africa	217	270	354	30.3	12
U.S.S.R.	180	214	245	22.4	11
Oceania	13	16	20	8.5	2

POPULATION PROJECTIONS, FOR THE WORLD'S MOST POPULOUS NATIONS ONLY

	1980	1984	2000	2025	2050	2100	Total Fertility Rate, 1984*
				(in millions)			
China	980	1,035	1,200	1,410	1,450	1,462	2.17
India	687	746	995	1,310	1,518	1,639	4.64
U.S.S.R.	265	274	306	340	358	376	2.34
U.S.A.	226	236	259	286	288	289	1.85
Indonesia	146	162	212	212	332	358	4.21
Brazil	121	134	181	243	279	299	3.82
Japan	117	120	128	132	129	128	1.71
Bangladesh	88	100	157	266	357	434	6.30
Nigeria	85	88	169	329	471	593	6.90
Pakistan	82	?	140	229	302	361	5.84
Total World	4,435	4,762	6,145	8,297	9,778	10,869	3.53

*Number of children the average woman would have during her lifetime.

Sources: World Bank; New York Times.

Total world population is growing so fast that every five days the net increase is well over 1 million persons. There were 4.8 billion people in the world early in 1984, i.e. *double* the global population in 1945. The net increase in 1983 alone was 85 million, an increase of over 1.6 million per week.

80 per cent of the world's population is in the Third World. (Over half the world's population lives in Asia). The average woman gives birth to about 8 children in Kenya, 7 in Syria and about 6 in Bangladesh and Bolivia. Compare West Germany 1.4, Italy 1.6 and U.S.A. 1.8. However, Simon and Kahn point out that although world life expectancy has been rising (on average), certain less-developed countries' birth rates (average) have been falling. Even given declining rates of increase achieved in the last 10 years, the rates shown will still be very high. Of course, there is considerable evidence that free market development in such places as Singapore and South Korea has led to natural declines in fertility. World population is estimated to reach 5 billion in 1987 and 6.13 billion by 1999, according to the United Nations. (It was only 2 billion in 1925). One estimate for 2030 is 10 billion, although the U.N. says that the world population will stabilize around the year 2100 at about 10.2 billion. The number of young adults in less developed countries will increase by 600 million between 1980 and 2000. That is just the increase, not the total number.

THE CONSUMPTION OF NATURAL RESOURCES, INCLUDING METALS SUCH AS SILVER, MUST SURELY THEREFORE ESCALATE TO A NOTICEABLE DEGREE.

Expectations of the underprivileged nations are rising, even though there may be insufficient wealth in those countries to provide the amenities.

EVEN IN QUITE POOR COUNTRIES, THE APPETITE FOR PRODUCTS OF CIVILIZATION THAT USE SILVER SUCH AS TV SETS, MEDICINES, CAMERAS, WASHING MACHINES, COMPUTERS ETC. WILL CONTINUE TO GROW DRAMATICALLY.

Africa has 25 of the world's 31 poorest nations.

D. Bogue and A. Tsui argue that world population will be between 5.7 and 5.9 billion in 2000, not the 6.13 billion above. This does not change the silver demand point to any appreciable extent.

3) Mass proverty is still the lot of two-thirds of the world's people and is likely to remain so, with such a vast and continuing increase in world population. More than 700 million people live in absolutely appalling proverty.

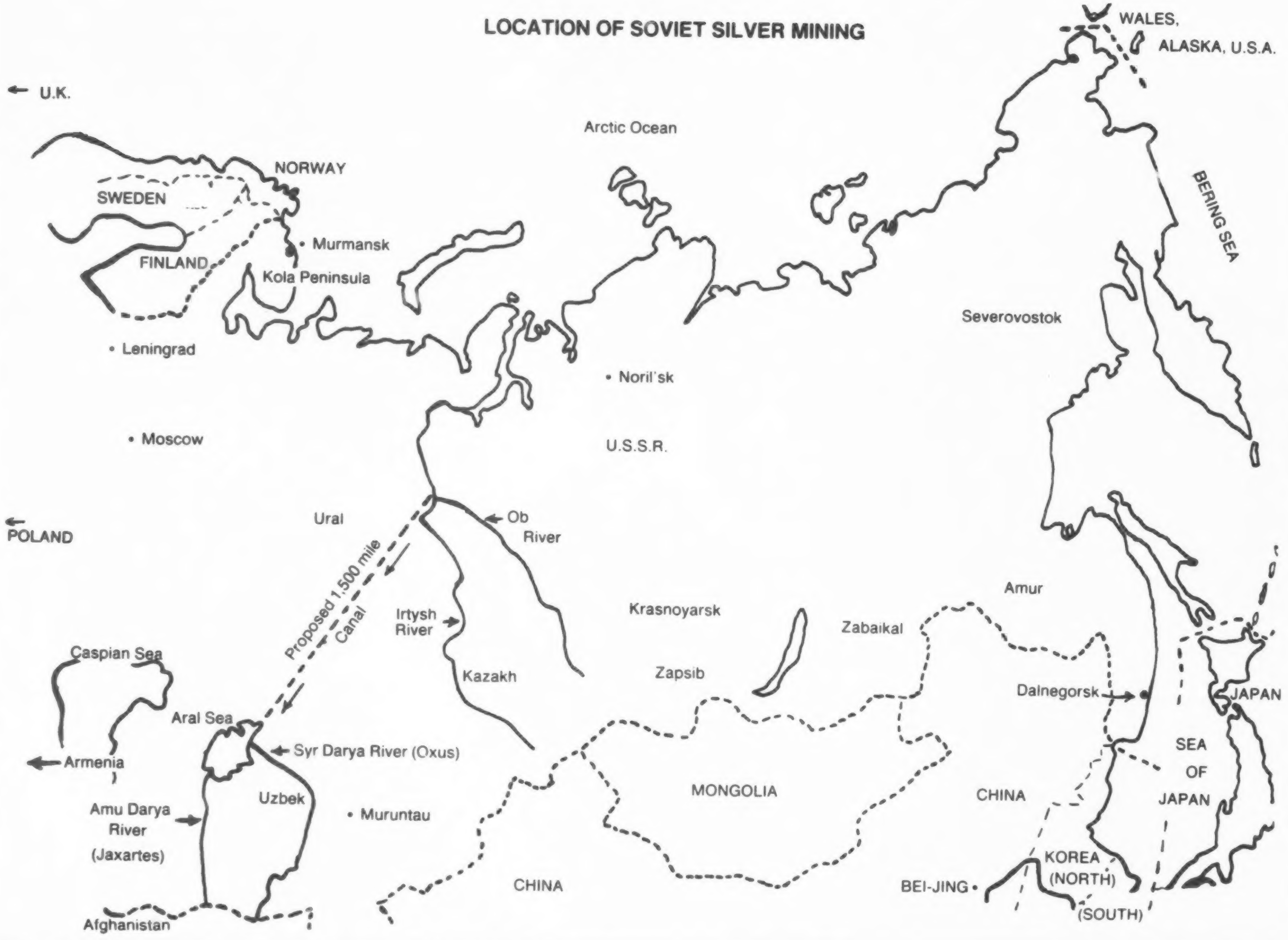
4) Food — Growing world population is going to put enormous strains on food supplies. The yield of grain per acre no longer increases at rapid rates. The outlook for great increases in output in the future is poor. It is said that, in order to feed the growing population of the world, food production will have to be doubled by the year 2000. Four to five times more fertilizing will be required.

Rarely have world reserves of food been so frighteningly low for those who need it and so many unable to afford to buy enough as now. Over 450 million people are seriously undernourished. One poor crop year in a number of countries can mean widespread hunger for those living there and this is already happening in more than twenty African countries. The U.N.'s FAO has stated that 1984 harvests will be poor for the third consecutive year in 24 African countries, including Angola, Mozambique, Ethiopia, Lesotho, Botswana, Zambia and Zimbabwe. An estimate 150 million Africans are threatened by famine and drought.

More than 100 million Africans are now affected by drought right now.

Sub-Saharan Africa has suffered from the worst series of droughts in the last few years and the disaster has been worsened by the fact that the area's 1960 population of 210 million has increased in only 24 years to almost 400 million. The horrors of this famine, particularly in northern Ethiopia, were highlighted to the world on television in 1984, prompting a stream of emergency food from Canada, U.S.A., Ireland, Britain, etc. etc. The area has the fastest population growth rate in the world, 3 per cent. (An average 3 per cent growth doubles the population in only 24 years.) Therefore, the Sub-Saharan population could be an incredible

LOCATION OF SOVIET SILVER MINING


WALES, ALASKA, U.S.A.
U.K.
Arctic Ocean
NORWAY
SWEDEN
FINLAND
Murmansk
Kola Peninsula
BERING SEA
Severovostok
Leningrad
Noril'sk
Moscow
U.S.S.R.
Ural
Ob River
POLAND
Amur
Proposed 1,500 mile Canal
Irtysh River
Krasnoyarsk
Zabaikal
Caspian Sea
Kazakh
Zapsib
Dalnegorsk
JAPAN
Aral Sea
Syr Darya River (Oxus)
SEA OF JAPAN
Armenia
MONGOLIA
CHINA
Uzbek
Amu Darya River (Jaxartes)
Muruntau
KOREA (NORTH)
CHINA
BEI-JING
(SOUTH)
Afghanistan

800 million hungry people by 2008. Zimbabwe, formerly Southern Rhodesia, has the highest population growth rate in the world, closely followed by Kenya. Half of all Kenyans are 14 years old or younger. Kenya's 1984 wheat crop is likely to be half of 1983.

The largest importers of grain in the world are (in order) the Soviet Union, 32 million tons approximately, Japan 24 million tons, North Africa/Middle East, 23 million tons, and China, 16 million tons.

The Soviet Union has had its fifth poor grain crop in a row and will need to purchase 50 million metric tons of grain in the winter and spring of 1984-85, worth U.S.$8 billion and will export gold etc. to pay for it.

Among the large importers of grain from the Western world, only the Soviet Union appears to have the ability to do something about the problem. Two schemes have emerged — good news for the silver price.

First, a decision has apparently been made to divert 10 per cent of the Sukhona river and water from the Onega and Pechora rivers north of Moscow, which flows into the Arctic, to the Volga, linked to the Don, which flow south to the grain-growing areas, by the year 1990. This could be irrigating a million hectares of land in the Northern Caucasus by 1990 and bring perhaps some water to the inland Caspian Sea where the water level has fallen drastically.

Later, in a second stage, presently estimated at U.S.$65 billion equivalent, about 6 per cent of the great Arctic-bound rivers Ob and Irtysh may be diverted south into parched Kazakhstan, to the Aral Sea 1,500 miles away, perhaps into the Syr Darya river (the ancient Jaxartes) and even the Amu Darya river (the ancient Oxus). This would, hopefully by 2000, result in 50 million hectares of new agricultural land, compared to 33 million currently. That increase in improved land would be about the size of Great Britain. This could result in 20 million metric tons more grain a year, or about 64 per cent of the amount the Soviets bought from the Western world in 1983/84 or only a mere 40 per cent of what will have to be imported in the winter/spring of 1984/85.

It would save them from exporting so much newly mined gold etc. to pay for imported grain, silver, etc. THIS WOULD HELP TO STRENGTHEN GOLD AND SILVER PRICES IN THE WESTERN WORLD.

Other estimates are that the improved lands would go from a current output of 20 million metric tons to 32 million tons by 1990 and to 55-60 million tons by 2000. This enormous second stage could not presumably be ready before 2000, even if started today, which is presumably not contemplated.

It involves digging a 1,500 mile, 660 foot wide canal to take some fresh water, about 6 per cent, from the mighty Ob and Irtysh rivers in Siberia that flow north and divert the water south to the inland Aral Sea in water-starved Kazakhstan, Uzbekistan and Turkmenistan. This projected irrigation project might have devastating effects on weather patterns all over the northern hemisphere, with unpredictable and uncontrollable consequences, according to some observers. It appears that the scheme will go ahead, not only because of the need for more water to increase the critically low Soviet grain output but also because it is vital to the central Asian region, the only part of the Soviet Union with a rapidly expanding population. Work might start as early as 1986.

After the high priority given to increasing meat and dairy products output by the use of more feed grains, the next highest priority is clothes — which of course means more cotton is needed. The prime source of cotton in the Soviet Union is the basin around the Aral Sea, a main beneficiary of the projected Ob-Irtysh diversion canal. The level of the inland Aral Sea is falling alarmingly — by 10 feet in the last 20 years and it could, without the new diversion canal, be dry by 2000.

Some experts say that Canada would benefit from the diversion as the Arctic Ocean becomes more salty and polar ice melts and ocean levels rise. It would also benefit from the higher world silver and gold prices.

The 1984 Soviet grain harvest was only 170 million metric tons, far short, once again, of the 238-243 million tons a year target under the 5-year Plan, 1981-85. The record Soviet grain harvest was 229 million metric tons in 1979.

If the weather pattern in many parts of the world worsens for the twenty years from 1986 on, as some predict, drought may become a normal situation in some places, rather than the exception. This could mean that, combined with other factors, millions of people and animals could die of starvation by 2000 or after. However, Simon and Kahn state that world climate does not presently show threatening changes.

Lows in sunspot activity are usually accompanied by drought. Such lows are due in 1985 or 1986.

The world's five warmest years during the 85 years of this century were 1937, 1938, 1943, 1944 and 1953.

The five coldest years were 1955, 1964, 1966, 1968 and 1972.

In the Northern hemisphere, the coldest set of 20 consecutive years was 1901-1920 and the warmest set of 20 consecutive years was 1934-1953.

It now appears likely that the build-up of carbon dioxide in the atmosphere will make the world warmer on the average in the near future, although warmer springs, summers and falls bring a greater likelihood of cold winters over the whole of central Europe, paradoxically.

Few countries have exportable surpluses of food for humans and stock animals. 80 per cent of the wheat that is traded internationally is harvested in September in the northern hemisphere in Canada, the U.S. and Europe. Effectively, the only surplus food countries are the U.S.A., Canada, Australia, Argentina and France. The U.S. government actually pays its farmers to plant less. However, about 25 million additional acres were under cultivation in 1984. U.S. stocks of corn, wheat and soybeans at early June, 1984 were much lower than a year before, with corn stocks down 57 per cent and soybeans down 42 per cent. The 1983 drought could have repeated in the critical period late July/August, 1984, but it was a bumper U.S. crop.

The Simon and Kahn report "The Resourceful Earth: A Response to Global 2000" said in mid-1984 that world food supplies — measured by grain prices, production per consumer and famine death rates — are improving and fishing catches are resuming an upward trend. It adds that, in the year 2000, the outlook for food and other necessities of life will be better and the world's people will be richer in most ways than they are today. The report added that water (supply) does not pose a problem that is unsolvable.

5) This mixture of ingredients may breed even more violent activist groups and terrorist activity and result in many more international incidents involving natural resources such as metals. The huge rise in the number of young adults in Third World countries guarantees continuing social, political and economic turmoil.

6) Cheap energy from natural resources in developing countries seems to be at an end.

7) Improvement in the Third World can be achieved. Look at the relative economic improvement in the last 30 years in India, China, Hong Kong, Singapore, South Korea and the Eastern Bloc.

Basically, those countries have a long tradition of dogged hard work, thrift and an ancient culture.

8) The world monetary scene is in turmoil and a distrust of paper money continues to grow and we see its effects in the increasing numbers of prosperous as well as modest people who are hedging into silver, gold, platinum, precious stones and jewellery and in the high price levels for many precious metals.

Parities are changing. Look at the rise and decline in the new wealth of the oil countries and the huge external debts of certain Latin American countries, Poland etc. Third World debt now totals about U.S.$800 billion, with $300 billion of that in Latin America. A new world monetary system, however, is not in sight, as far as one can perceive.

Gold and silver have started to come back into their own as inflation has been spreading and accelerating throughout the world. Early in 1984, U.S. interest rates were at historic highs, when adjusted for inflation. People in higher income brackets continue to build inflation expectations into their personal planning.

Silver, which has been an inflation hedge of the relatively poor, will undoubtedly be used more and more for this purpose by the lower income groups as inflation continues to accelerate. The fact that citizens in some countries are forbidden to buy gold bullion intensifies the upwards pressure on the price of silver — the normal alternative — and continues its monetary image as the only substitute for gold as a store of value.

In any case, barring a world depression or a world war, it appears that current inflation, value of the dollar and mineral taxation levels would seem to militate against a return to the price range of the early 1970's or 1979-80 for silver and other metals, although I should remind you that silver was trading at only $1.40 an ounce as recently as twelve years ago.

In the foreseeable future, the silver price will be unavoidably tied into a price ratio to gold and the silver supply level will also be increasingly locked in to the demand situation for low grade copper deposits (not silver) and of other base metal ores. The demand for the latter is expected to be relatively poor through 2000.

The U.S.A. has always had a love affair with silver in its monetary status. Silver's price position relative to gold has improved over the last few years. The former U.S. Government official purchasing price for silver, set in 1934, fixed the range of the silver/gold price ratio for over 33 years, but in 1973, after six years of the free price, the ratio fluctuated between 45:1 and 30:1.

The silver/gold ratio is now about 50:1, meaning that the silver price is over twice as strong relative to gold as it was fifty years ago. If its relative strength were to double again, we might be at the historical 15 or 16:1.

Silver is unique. If only it were not so scarce, we would use more of it. Most uses of silver will continue because of its unique properties, electrical and thermal conductivity, its photo-sensitivity, its optical qualities, ductility, corrosion resistance, etc.

Further, some of the unique characteristics of silver are going to be more fully exploited, for example, as a bactericide in preventive medicine and in other innovations in treatment.

In the old days (even 12 years ago), silver was so cheap that we used solid silver and alloys. However, silver clad and silver plated cheaper base metals and alloys are taking over more and more.

Canada is the third largest mineral economy in the world. Ontario's mineral output in 1973 was valued at almost $2 billion and reached $4.5 billion in 1980.

Canada has occasionally in the recent past been the world's leading mine producer of silver at over 1,600 metric tons a year — and about a third of this silver comes from Ontario. Ontario alone typically produces about 8 per cent of the world's newly mined silver. Until quite recent years, Ontario had the world's single largest silver mine, discovered twenty years ago at Kidd Creek, Timmins.

North and South America together produce about three quarters of the free world's newly mined silver. Silver is quite a scarce metal. Most rich silver deposits are found near the surface of the earth, like cream on fresh milk and therefore many experts believe that most of the rich silver deposits have already been discovered and are being exhausted at a rapid rate.

Today we get most of our silver because we are mining copper, lead, gold, etc. However, increased gold or base metal mining does not necessarily mean more silver production because, as a general rule, as these mines are forced to go deeper, less and less silver tends to be found.

What about the year 2000? Well, here are some points to consider:

1) Total Western World demand for silver may be 16,000 metric tons in 1990 and by the year 2000 demand could be in a bracket of 18,000 metric tons to 19,000 a year, compared to current silver consumption of over 13,000 tons a year and current mine output of only 9,500 to 9,900 metric tons a year.

2) Consumers will have only two serious sources of physical refined silver — the mines and the increasingly important secondary refiners, who will have been improving their recoveries of silver from scrap. When prices go higher, the incentive to recover from scrapped old silver increases. Secondary refining might double quite easily or even triple in such a case.

3) Economic pressure for substitution by other materials in some uses of silver will intensify as the silver price rises.

4) The message from the world's mines producing silver is that there is to be very little overall growth in total annual output. By itself, this is neither bullish nor bearish for the price of silver. However, the most probable scenario on total demand for silver in the world is that it will grow noticeably each year for a variety of reasons. This situation will tend to force the silver price up.

5) Although it mined more silver than the U.S.A. in each of the last few years, the Soviet Union, one of the largest mine producers, provides no evidence that it will be able to export any large amounts of silver, so the Western Hemisphere will probably continue to be the chief mine source for silver for the rest of the world.

6) Deep sea nodule mining, perhaps starting full-scale in the 1990's, will not help much either because the silver content is only in parts per million, but it will be a very important source of copper and therefore somewhat bullish for the silver price. Nodule recovery levels from the seabed could clearly act as a depressant on the output of some low-grade or marginal land-based copper mines and that event therefore, in turn, would reduce the amount of by-product silver produced on land, thus slightly strengthening the silver price.

7) A trend to highly mechanized mining underground in industralized countries, reducing costs by reducing jobs.

8) 90 per cent of the world's measured land-based silver reserves are in base metal deposits, often at great depth.

   A doubled silver price and improved mining technology might appear to triple the quantity of land-based mineable world silver reserves, which are mainly in low grade deposits, but extraction rates would still be chained to world demand for copper and for lead to some extent. Certain individual mines could then become "silver mines" where silver becomes the most valuable of the metals extracted.

   Most of the world's known land-based reserves of silver — at current price levels — are estimated to be in the Northern Hemisphere, i.e. Canada, U.S.S.R., U.S.A. and Mexico, in that order.

   Very few major silver-bearing base metal mines have been discovered in the world since the Ontario mines of Texasgulf and Mattabi a few years ago.

9) The difficulties involved in calculating future reserves may be illustrated as follows: About ten years ago, the U.S. Bureau of Mines made an assessment of known world mineral resources, (as opposed to recoverable mineral *reserves* of a realizable commercial value), and while not claiming more than 65 per cent confidence in the results, suggested that there may have been then as little as 22 years of silver left in the ground. Recoverable ore *reserves* of silver would probably be about half of that resource figure level, so on that kind of basis, the early 1990's would have been indicated as a termination for silver ore reserves as they were known in 1973. However, the U.S. Bureau of Mines 1980 estimates postpone that termination possibility into the 2000's.

   The caution here is that actual proven reserves of such metallic ores seldom need to be identified in excess of 12-15 years supply, but of course this may not continue to be the case indefinitely.

10) Far more exploration activity is clearly required if the silver consumption-supply shortfall is ever to be permanently resolved.

It will be extremely interesting to see where consumption will go, where all the silver will come from, and at what prices.

There is right now a fundamental oversupply of readily saleable silver. Free world mine output of silver which had been at a plateau of about 7,770 to 7,840 metric tons a year for many years, has now inched up to a range of 9,500 to 9,900 metric tons a year, with the higher price.

There is a considerable difference of opinion about estimates of future mine production of silver. However, many observers feel that there will probably not be much change in total world output in the next few years.

Almost half of the free world's newly mined silver comes from North America these days.

The combined Mexico, Canada, Peru, and U.S. (i.e. the bulk of North and South American) mine output of silver in recent years was as follows:

(metric tons)

1980	**1981**	**1982**	**1983**
4,889	5,367	5,740	6,010

Canada

Canada became the free world's largest mine producer of silver in 1968 and except for one year, remained in that position through 1974. Mexico and Peru have been the leaders ever since. The U.S. slipped to 4th place in the Western world in 1980 and again in 1981, behind Canada.

Kidd Creek Mines, (formerly Texasgulf Canada), at Timmins, Ontario, once the world's single largest silver-producing mine, remains a large mine producer of silver in Canada.

Ontario's 1980 mine output of silver was 461 metric tons, valued at $335 million, a record. 1981 production was lower at 324 tons, but the 1984 output figure was estimated as 506 metric tons.

Other Factors

Even the Solidarity union troubles in Poland reduced by-product output of silver in the mines there, probably by 190 to 200 metric tons a year and the Soviet Union itself became a net buyer of silver in the West from 1981.

Other events affect the price, e.g. silver sales from government stockpiles and increasing recovery of silver from scrap and the melting down of coins. Imports from Indian hoards were well over 900 metric tons in 1981. The great performance of agricultural production in India in recent years and the low silver price almost certainly mean that the smuggling of silver bullion out of India may be less than the average of previous years.

Recovery of silver from old scrap has risen from 800 metric tons a year in the 1960's to an average of perhaps 3,000 metric tons a year.

The U.S. government commenced selling a total of over 3,155 metric tons of silver from stockpile over 3 years from October 1, 1981, starting with about 39 metric tons a week. However, the U.S. General Accounting Office (GAO) reported on the silver sales to the U.S. Congress towards the end of 1981 and the silver auctions were stopped, which was slightly bullish for the price. Only about 63 metric tons were actually sold. Nevertheless, these sales may recommence in the future, involving perhaps as much as 300 metric tons a year and this quantity naturally continues to overhang the market. The revenue from silver is seen by some as needed by the government to assist in justification of the purchases for stockpile of iridium metal etc. A special intragovernmental group was said to have agreed to recommend that sales from the U.S. silver stockpile be resumed.

Individuals in the Western world selling off their silver to raise cash, (on which interest can be earned), are also a factor. High interest rates attract the speculators away from commodities, such as silver, gold, platinum and copper, into investing in the money and money futures market instead. Low interest rates do not appear to be on the horizon. Silver might get back up to as high as U.S.$15 if only, as a solitary factor, the U.S. prime lending rate were cut to say around nine per cent, but in reality the rate could still be in the 12 to 15 per cent range in the latter part of 1985. The eminent firm of Samuel Montagu said in May, 1982 that a 50 per cent silver price rise from the then level of about $8 would not be surprising when market sentiment changes.

Of course, the silver market itself is basically supremely indifferent to the opening or closing of individual mines, (or to mining cost problems), as long as the overall supply and demand balance is not too dramatically disturbed, as is the case in the small net loss of only two hundred metric tons or so a year in recent years in the U.S. mine output of silver, partly offset by new production.

Equally, unlike gold, where such prices enable mines to take out lower grade ore and with lower prices go to a higher grade, newly mined silver output is fundamentally the prisoner of base metal production, (except in the U.S.A. and parts of Mexico) and cannot be increased or decreased at will to take advantage of silver price changes until they become quite dramatic.

Consumption of silver is said by some observers to be very sensitive to the silver price, a function or barometric reading embracing industrial demand, speculative demand and perceived supply. World industrial consumption has in the past generally been up to twice the level of newly mined silver output, during the last quarter century. Secondary refining of scrap is filling the gap. When overall consumption in any year is lower, (and therefore prices), this source can decline anyway.

The leading consumers of silver, after many years, still remain the same, i.e. the U.S., Japan, Italy, West Germany, the U.K. and France, in that order. Countries which are mine producers of silver, such as Mexico and Peru, marketed substantial mintings of silver coins in recent years.

Silver-consuming companies are managing their silver inventories more efficiently than ever in an attempt to stay hand-to-mouth, reflecting the high cost of money etc. There may be a move in business away from an inflationary psychology to a deflationary psychology. Even so, there are sizeable stocks of silver metal still available.

In the western world, the manufacture of chemicals, films and printing papers for the photographic industry accounts for about 40 percent of the annual consumption of silver. This major market may be threatened over the next decade by the development of the much talked of, (but still elusive at a reasonable price), silver-free photographic film that would be really competitive. New photo-technology should not be a really major factor in the silver market for many years yet. On the positive side, silver is being employed in increasing amounts as a catalyst in some water purification processes and many other new uses. Thus any reduction in silver consumption by the photographic industry may be offset by increased demand for environmental and health and new industrial uses.

Having considered the known variables, it appears

1) that world silver consumption should increase gradually,
2) that excess silver inventories in industry as well as government silver stockpiles should continue to be reduced and
3) that near-normal supply/demand patterns should be resumed later this decade or shortly thereafter.

Silver should show extremely favourable price increases on a percentage increase basis, compared to the base metals.

In the U.S.A., the silver price, which was freed in 1967, soared dramatically in both 1974 and 1980 and each time plummetted just as quickly to a low level. It is unlikely that the 1980 high will be seen again for several years, barring a major war or a sensational world boom.

Most precious metals market analysts expect silver and platinum prices to rise much faster than gold when the economic improvement commences, particularly silver. The outlook for the silver price is very good. Of all the important metals mined, silver appears to be the one most likely to offer the highest increase in mine revenues per unit produced over the next decade. Gradual strengthening of the world silver price should improve the earnings of base metal mines, many of which produce silver as a by-product. As the silver market improves, a number of small silver-cobalt mines may again become profitable.

7.2 SILVER ORGANIZATIONS

7.2.1 SILVER INSTITUTE

The Silver Institute acts mainly as an information source and a public relations body to foster the use of silver.

MEMBERS

Silver mining companies, refiners and manufacturers, central banks in some countries, chartered banks and suppliers of silver and silver products. Total membership comprises organizations from many countries.

BUDGET

Assessed dues from members calculated on the basis of accountable silver in ores and concentrates shipped, plus ounces of silver refined, plus ounces of silver content in products fabricated or manufactured.

HEADQUARTERS

Washington, D.C., U.S.A.

OBJECTIVES

To encourage the development and use of silver and silver products.

To help develop markets for silver and its products.

To foster research and development related to the present and prospective uses of silver.

To spread knowledge and understanding of the uses of silver.

To develop methods for improving the welfare of the silver industry.

To collect and publish statistics and other information about production, distribution, marketing, consumption and the uses of silver and silver products.

ORGANIZATION

Silver Institute affairs are carried out by a private U.S. management firm, with the president of that firm acting as Manager of the Institute.

Distribution of information through a monthly newsletter, brochures, etc.

Sponsors meetings and organizes symposia on matters relating to the use of silver.

SOURCE OF DATA

The Silver Institute has organized the publishing of mine production data annually, based on information obtained from questionnaires submitted to cooperating silver mining companies. Refining data are assembled on the basis of confidential submissions from refiners and are available to members only in aggregated form.

This system was designed in 1971 by a 3-man committee comprising the present Managing Director, Richard L. Davies, George Havener of Asarco and Tom Mohide, then with Engelhard, U.S.A., now in the Government of Ontario, Canada.

In the great complex of investment and labour which finds and moves silver from the depths of the earth to become the millions of silver products enriching our lives, there is a central gateway through which the silver flows. It is the silver refining operation — taking silver containing materials and from them producing 999 fine (999 parts per 1000) or even purer, silver bars.

Through the extraordinary cooperation of refiners around the world in confidentially reporting the amounts of their individual operations, The Silver Institute is able to report the aggregated totals back to them promptly, and to publish these totals in The Silver Institute Letter.

One group of totals covers all known U.S. silver refiners. The Non-U.S. group covers all known refiners in seven countries and some in other countries. In each group we can watch the amounts of the silver bars made from four sources: from primary (ores and concentrates); from coins; from "old" scrap (from used photo film and other used products); from "new" scrap (from in-plant clippings, spillage, sweepings, etc. generated during manufacturing processes).

Primary figures indicate monthly changes in the amounts of silver ore which are mined and concentrated by milling, flotation, smelting, leaching or other processes for delivery to refiners.

Coin figures show the 999 silver made by melting and refining silver coins.

Old scrap figures show monthly changes in the amount of used silver-containing products which people can afford to find, collect, and process at the price of silver current at the time.

New scrap figures show the refining of scrap generated in the manufacturing processes of previous months.

Total production figures are important because they show the monthly changes in the amounts of 999 and pure silver being created.

The refiners also report confidentially their individual disposition of the refined silver they produce, indicating how much is converted in plant into fabricated products, and how much is shipped out as 999 silver bars. Just as for production, The Silver Institute reports U.S. and Non-U.S. totals of these dispositions.

The 999 silver converted into fabricated products in the refiners' plants is only a part of all silver fabricated. However, monthly changes in these figures are indicative of changes in total fabrication.

ORIGINS OF THE INSTITUTE

In 1972 ten companies formally joined together in a successful effort to create an organization to work for the advancement of the interests of the entire silver industry. As a result, the Silver Institute was formed and today it has well over 100 corporate members in 25 countries.

As the Institute has grown, the dues paid by the new member firms have been applied to doing more to encourage the development and use of silver products, help develop markets for silver and its products and to collect and publish statistics and other information about production, distribution, marketing, consumption and the uses of silver and silver products. The Institute carries out these activities through the publication of its bimonthly "Silver Institute Letter", its unique and prestigious quarterly "New Silver Technology", another unique report, "Modern Silver Coinage", which is issued annually and other periodic publications such as its book, "Siiver Refiners of the World and their Identifying Ingot Marks".

In addition to receiving timely published information, Silver Institute members have immediate access to the Institute's library and other data on silver and the silver industry. Members also attend Silver Institute meetings where representatives of leading miners, refiners, bullion dealers and those who use silver in their products, hear up-to-date technical and statistical information of interest to all parts of the silver industry and to the public at large.

More recently, the Institute has aggressively promoted the use of silver products in "premium", "incentive", and "employee recognition" programs through exhibits in trade shows. As other firms join the Institute, more new activities are launched and effective on-going activities expanded — all aimed at improving the welfare of all who mine, supply and use silver and silver products.

"SILVER" AMONG THE MOST POPULAR FILMS

During 1982, the 28-minute sound and colour film "Silver", (produced by The Silver Institute), was shown 13,450 times to a total of 416,493 persons. It is the third most popular film in the U.S. Bureau of Mines film loan program, according to a recent report by the Bureau. The Silver Institute has provided 300 copies of this film to the Bureau for circulation on a free-loan basis to schools, civic and business groups, scientific and professional societies and other organizations. Just during the third quarter of 1984, "Silver" was loaned to organizations in the United States, most of which were high schools, colleges and universities and shown 1,229 times and seen by 36,000 viewers.

Requests to borrow prints of "Silver" may be addressed to Motion Pictures, Bureau of Mines, U.S. Department of Interior, Pittsburgh, PA which will lend them for showing in the United States only.

Copies of "Silver" in English, or with Spanish, German, French of Japanese soundtracks, may be purchased from The Silver Institute in the form of films or video cassettes.

7.2.2 INTERNATIONAL PRECIOUS METALS INSTITUTE

The International Precious Metals Institute, (I.P.M.I.), of New York and Allentown, Pennsylvania, is an international association of miners, refiners, producers, users, research scientists, merchants and governments formed

1) to encourage the exchange of technology and information such as publishing of data and statistics;
2) to conduct educational meetings and
3) to continually promote the greater use of gold and silver and the platinum group metals.

It covers the whole range of silver usage and has issued some data on mining, uses and statistics.

The institute is a non-profit organization whose main objective is to coordinate information in all areas of precious metals, as well as provide liaison between industry, conservation groups, governments, educational institutions and the general public in problem solving and in the dissemination of information in the areas of vital uses of precious metals.

A further objective is to cooperate with, but not compete with, established precious metal trade, scientific and educational organizations.

The late Ray Vines of International Nickel of Canada Ltd., (Inco), came up with the original concept of this successful organization. After several years of study, a small group of enthusiasts came to the conclusion that

1) there was a need for such an institute, and
2) a neutral ground, such as a university, was needed to nurture the seedling. New York University filled that need.

The Institute came into being in 1975. The writer, a founding member, has been a part of this effort since the first meeting.

The 1984 Annual World Conference of the Institute with a program organized by T.P. Mohide was held in June in Toronto, Ontario, Canada under the chairmanship of David Rose of Imperial Smelting and produced new records for attendance and money-raising for research and scholarships.

7.2.3 SILVER USERS ASSOCIATION, WASHINGTON, D.C.

Represents the manufacturers of silver artifacts.

7.2.4 STERLING SILVERSMITHS GUILD OF AMERICA

The Sterling Silversmiths Guild of America present stunning displays of sterling silver craftsmanship — for example, winners in a nationwide contest of student silversmiths — including a magnificent chalice of curvilinear form, a contemporary interpretation of traditional design and a five piece place setting hand-crafted in graduated wedge design forged from silver cast ingots — the top prize winners.

The Manufacturing Jewelers & Silversmiths of America also promote the sale of artifacts of all the precious metals.

7.2.5 THE PRECIOUS METALS INDUSTRY ASSOCIATION (P.M.I.A.)

President:	Robert F. Mansell, Director — Investor Products, Engelhard Corporation
Office:	82 Wall Street, Suite 1105, New York, NY 10005, U.S.A.

Executive Director: David U. Groves

The P.M.I.A. Inc. of Washington, D.C. is a non-profit organization formed to include all phases of the precious metals industry in one organization, emphasizing the investment and business side of precious metals, jewellery, industrial uses, chemical and architectural industries etc. It will promote common business interests and principles, education and information for industry.

The first P.M.I.A. Exposition and Conference, "Precious Metals Expo'85" will be held in Orlando, Florida, March 25-27, 1985.

This will be a unique opportunity for leading financial institutions and exchanges to expand their role in the precious metals investment market by promoting precious metals products and services.

Chapter 8

8.1 STOCKS OF SILVER BARS IN STORAGE

Drawdowns from considerable accumulations of above-ground refined silver stocks and secondary recovery have for decades continued to fill the sizeable net supply deficit or "gap" between total world mine production and total world consumption by industry and the arts. Back in 1973, new mine production satisfied only just over half of industry's needs and the "primary gap" amounted to about 7,280 metric tons, according to Mocatta.

Perhaps a world total of as much as 200,000 metric tons of silver in tradeable metal form exists in stocks on the surface, which represents about 16 years of newly mined output at say 12,000 tons a year.

243,000 metric tons is the estimate given by Shearson Lehman/American Express, London, including India's holdings.

Compare gold, 1,400 tons mined per year and about 65,000 tons currently stockpiled, representing over 46 years of newly mined output of gold.

These above-ground stocks of refined silver have been drawn down noticeably (by as much as 3,300 metric tons a year as early as 1974).

In 1983, India's exports were about 660 tons of silver, sales from stocks of governments of some 750 tons, demonetized coin providing 250 tons and 2,750 tons recovered from scrap.

1983 saw determinable world stocks of silver increase over the 1982 figure. The growth of these stocks undermined confidence in the minds of investors in the U.S.A. Peter Cavelti points out that more than 3,000 metric tons of silver were added to private U.S. hoards in 1983 alone.

World stocks of silver have increased by over 22,000 metric tons during the last five years.

There is, to be frank, an awesome amount of silver in the world at hand and ready for market. However, even record high exchange stocks of silver may not prevent rallies in the silver price in a changing economic environment.

Handy and Harman estimated early in 1984 that total reported world stocks of silver grew to some 74,000 metric tons by the end of 1983 and silver holdings accumulated by private investors stood at over 31,000 metric tons.

World silver stocks rose by 5,373 metric tons in 1984, according to Shearson Lehman.

Early in 1984, very large quantities of silver metal bars appeared to be in storage vaults in the New York, Chicago Winnipeg and London commodity exchanges, with dealers and traders, with the silver-using industry itself and with individuals.

The prominently reported total stocks of LME, London and Comex, New York, at mid-April, 1984 were 5,130 metric tons, equivalent to 5 months of world mine production, which is bearish for the price.

The silver stored in the principal commodity exchanges in the U.S. and U.K. at the end of December, 1983 was 1,728 metric tons higher than a year earlier. End-1982: 4,445 metric tons. End-1983: 6,173 metric tons.

Three Exchanges	End-1982	End-1983	1984	
		(metric tons)		
Commodity Exchange (Comex) New York	2,837	3,963	3,536 (late Nov.)	
Chicago Board of Trade	492	798	625 (late Nov.)	
London Metal Exchange	1,116	1,412	1,600	(March)
	4,445	6,173	5,130 (mid-April, excluding C.B.O.T.)	

Total Comex and LME silver inventories were 130 per cent higher in July, 1984 than they were in January, 1978. This factor by itself would be bearish for the silver price.

There is a tendency to think that the silver in exchange warehouses is readily available for delivery. It is not.

By June, 1984, silver inventories in exchange warehouses amounted to 5,910 metric tons of silver, up almost 2,500 metric tons from one year before. This stock increase (or decrease) does not necessarily indicate a fall or rise in the silver price.

One of the reasons why stocks of physical silver at U.S. and U.K. commodity exchanges rose so dramatically in 1983 was that individuals in certain countries that have massive external debt problems, such as Brazil, Mexico, Argentina etc. shipped a large amount of their personal silver out to the U.S.A. and the U.K. because they were worried about the safety of that silver within their own countries, fearing that desperate governments might seize it — a well reasoned conjecture.

Gold is being smuggled from Argentina into neighbouring Uruguay, destined for the U.S., thus avoiding strict Argentine currency and export controls. 50 per cent of the newly mined gold in Brazil is almost certainly smuggled out of the country.

Silver is not considered to be a target for confiscation by the government of any major Western country, but, of course, gold is — whether held by investors in the form of gold bullion bars or coins. The U.S. took this action last in 1934. On December 31, 1981, Trans World Airlines lost a shipment of Krugerrand gold coins destined for the Franklin Mint. Gold was selling in the U.S. for U.S. $399 an ounce that day. The insurance company said that the "official" price of gold in the U.S. was U.S. $42.22 an ounce. The Supreme Court of the United States decided that $42.22 an ounce was indeed the real "official" price in the U.S. of gold bullion last set in 1973. If and when confiscation of privately held bullion takes place, that is quite likely what gold would be considered to be worth officially, in the U.S. by the courts and the government.

Non-U.S. refiners had stocks of silver estimated by the Silver Institute at end September, 1984 as 217 metric tons, compared to 119 tons a year before. U.S. refiners' stocks of silver at end September were 98 metric tons, about unchanged from one year before.

8.2 WORLD VISIBLE STOCKS OF REFINED SILVER – ESTIMATED

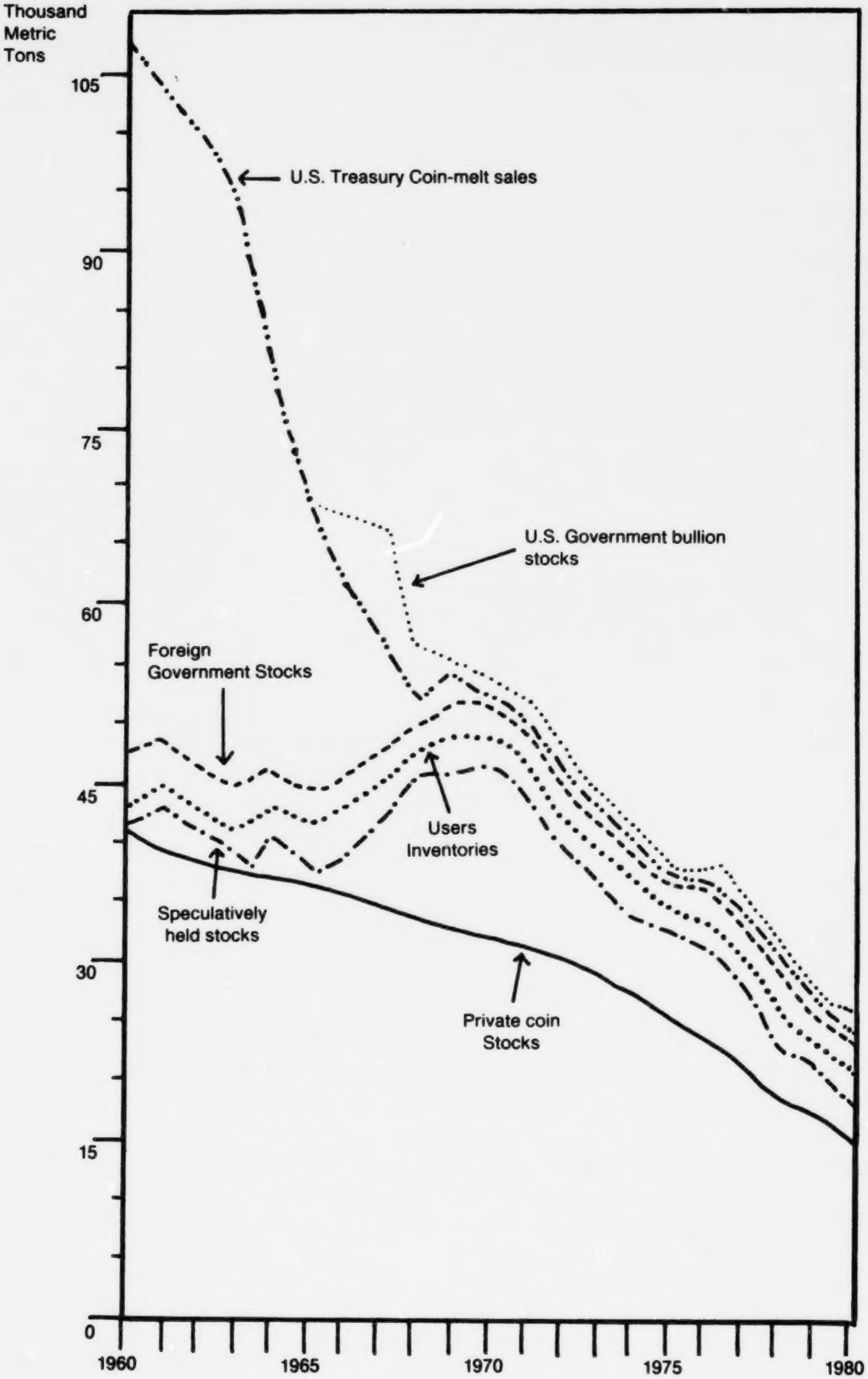
(excluding Soviet Bloc counties)

Above ground Availability of Refined Silver

		End-1982	End-1983
		(metric tons)	
Exchange Stocks			
London Metal Exchange		1,116	1,412
Commodity Exchange (Comex) New York		2,837	3,963
Chicago Board of Trade		492	798
Total of U.S. Futures Exchange stocks only, yearend, (U.S. Bureau of Mines say 1981: 3,002)		3,329	4,762
Industry Stocks			
Industry Stocks, U.S.A. only (1981: 649)		642	552
Total, Exchange and Industry (including sundries)		5,050	6,725
Total Visible Stocks		8,379	11,486 (11,713 Shearson Lehman)
U.S. Government Stocks			
Strategic Stockpile, 1982		4,276	4,260
Defense Department		150	n.a.
Treasury (the U.S. Mint)		1,140	1,050
Total (U.S. Bureau of Mines Figures)		5,475	5,355
Stocks of Governments outside the U.S.A.		4,670	n.a.
Government Stocks, worldwide (1981: 10,265)		10,140	10,020
Other Stocks, Estimated			
Bullion stocks in U.S. and elsewhere,	**Unreported**	23,950	23,950
U.S. silver coins held privately,	estimated	26,500	26,500
Foreign silver coins held privately,	estimated	780	780
Total		51,230	51,230
Grand Total of Silver Stocks, estimated		66,516	68,000 est.

Sources: Ontario Mineral Resources Branch; Handy & Harman; Silver: U.K. Mineral Dossier No. 25; U.S. Bureau of Mines; J. Aron/Goldman Sachs.

ABOVEGROUND STOCKS OF SILVER



It appears that there are also very considerable unreported stocks of silver bullion and coins in the U.S.A. which, under certain circumstances, could provide a telling extra supply of silver to the market.

It is estimated that 20,000 metric tons of silver contained in old U.S. coins were held privately in the U.S. alone in 1982. Perhaps 80 tons or more in silver coins were held outside the U.S.A. in Europe and particularly in China.

There are also an estimated 27,000 metric tons of silver in silverware held by U.S. individuals, some of which might eventually enter the market.

8.3 U.S. GOVERNMENT SALES OF SILVER

U.S. FEMA (Federal Emergency Management Agency)
Stockpile Goals (Desired Inventory Mix)
and Inventories
as at September 30, 1983

	Goal	Inventory
	(metric tons)	
Silver (fine/pure)	0	4,276

The 4,276 metric tons of silver in inventory or part of it may be put on the market by the U.S. government since the Stockpile Goal is zero.

Such excesses in hand which are over the goal can be sold by the U.S. government to generate funds to purchase other more vital materials.

Silver sales would present problems of market interference, especially if sizeable quantities of silver were sold in a short period of time, diluting the silver prices considerably. The U.S. Strategic Stockpile of over 4,000 metric tons of silver, some U.S. authorities say, is far too much.

The U.S. Stockpile "objective" or "goal" for silver was reduced to zero in 1977, on the basis of the security of supplies from Canada and Mexico and therefore sell-off of the accumulated silver started in 1981. The stockpile was 5,200 metric tons in March, 1982.

This U.S. government strategic stockpile of silver bullion bars was 5,100 metric tons of silver in November, 1982.

The U.S. government had commenced selling a total of over 3,155 metric tons of silver from stockpile over 3 years from October 1, 1981, starting with about 39 metric tons a week. However, the U.S. General Accounting Office (GAO) reported on the silver sales to the U.S. Congress towards the end of 1981 and the silver auctions were stopped, which was bullish for the price. These sales threatened to depress the already low price of silver still further and were discontinued. Only about 63 metric tons were actually sold. Nevertheless, these sales could recommence in the future, involving perhaps as much as 300 metric tons a year and this quantity naturally continues to overhang the market. President Reagan has recently authorized the sale of 310 tons during the year but the sales may not take place because of political representation. The revenue from silver is seen by some as needed by the government to assist in justification of the future purchases for stockpile of iridium metal etc.

A special intragovernmental group was said to have agreed to recommend that sales from the U.S. silver stockpile be resumed. The U.S. government apparently still wishes to reduce its silver and may resume holding auctions when the market for silver appears stronger. This is bearish for the silver price.

A Congressionally mandated study, (to be made by the President), of future defence needs is awaited.

A U.S. Congressman once said that selling the U.S. silver stock was like selling the family jewels to buy a sports car.

However, sales of silver from the U.S. government strategic stockpile are now limited by a new law, (December 21, 1982), to the countervalue of 10 per cent of the annual U.S. mine output of silver each year, which would appear to mean a limit of up to 124 to 127 metric tons a year, based on the annual average for 1981, 1982 and 1983.

Nevertheless, President Reagan has proposed in his 1985 budget the sale of 155.5 metric tons (5 calendar quarters at 124 tons a year?) of silver during the fiscal year beginning on October 1, 1984 — the value then being about U.S. $47 million. The White House is said to prefer to sell the silver as bullion, but it may be marketed as coins. No sales appear likely before the first quarter of 1985. This budget proposal is slightly bearish for the price.

However, in April, 1984, the U.S. House Armed Services Committee approved the sale of 310 metric tons of silver during the upcoming fiscal year from the U.S. national defence stockpile, which then held 4,260 metric tons of silver, with the proviso that the funds from such sales would be used to purchase materials more critical to the U.S. It also suggests that the silver be made available for purchase by as many Americans as possible, contrary to the G.S.A.'s desire to dispose of it in large parcels. This was later changed by the Senate to 2 years, limiting the use to coinage. The U.S. senate voted to permit the government to sell stockpiled silver, but only if the metal is used to make coins, preferably restrikes of the Morgan silver dollar, or a 1-ounce silver $1.00 face value version of 1808 St. Gaudens model dollar. This proposed sale of 310 metric tons is bearish for the silver price but meanwhile, in an election year, the odds are that this may produce no sales in calendar 1984.

The U.S. government silver stock has meanwhile been drawn upon for such coins as the Los Angeles Summer Olympics of 1984 and the George Washington and other commemorative pieces, (367 metric tons of silver in 1983).

Sunshine Mining's stockpile of silver, about 16 metric tons in August, 1984, was still growing.

In 1983-84, a number of third world countries such as Peru were selling off substantial quantities of their silver bullion holdings because of their very large external debt problems and thus contributed to an undermining of the silver price. In 1983, these government sales amounted to almost 460 metric tons of silver. Peru alone sold 290 tons in 1983 and another 62 tons in the first half of 1984, leaving only 31 tons in the reserve. Many countries also sell gold in order to obtain foreign currency from time to time.

The Soviet Union may have 2,200 metric tons of silver bars in stock, which is quite small, say less than year's supply, when compared to total Soviet silver consumption each year, with its important defence component.

The Soviet Union sells gold and silver for cash for the purpose of purchasing urgently vital wheat and other commodities from the West. In 1982 and 1983, Soviet sales of gold and other metals were relatively high in order to compenssate Eastern Bloc countries for the disastrous 1981 harvest and for their increasing difficulty in obtaining additional hard currency loans.

The U.S.S.R. and her satellites have been virtually bankrupt by our standards and some of those countries may have to ask for extended moratoriums on the repayment of existing loans, which would probably lead to significant and additional releases of Eastern Bloc gold to Western markets, (diluting the gold and the silver price), especially when there are Soviet grain crop failures. The Soviet grain crop was about 25 per cent below target in five consecutive harvests, 1980, 1981, 1982, 1983 and 1984.

However, in the first quarter of 1984, the U.S.S.R. was running a surplus in dealings with the West. The Soviet net debt in hard currencies may not have been more than 9 billion U.S. dollars. Poland's hard currency debt was an enormous U.S. $27.5 billion, rising soon perhaps to U.S. $30 billion. Hungary owed 7 billion dollars and Bulgaria $2 billion.

Charles River Associates expect that up to 12,400 metric tons of silver bullion held by speculators will be sold during the period 1985 through 1994.

Gold bullion reserves held by governments either directly or through international institutions are estimated to be the equivalent of 30 years of present total world mine production of gold. The total amount of refined gold world-wide is equal to between 60 and 120 years of production. The U.S.A. gold bullion reserves dropped over 12.44 metric tons to 82 metric tons since 1950 whereas the European countries and less developed countries have increased holdings by a total of 14.3 metric tons in the same period.

Silver stocks in refined form at all known "free world" refiners in Canada, Mexico, Peru, South Africa, Sweden, Australia and others in Europe and Asia fell in 1981.

In that one year, the change in the U.S. and non-U.S. levels can be seen to have resulted in a net move of silver to the U.S.A., i.e.

i) U.S. stocks increased by 56 metric tons.

ii) Non-U.S. stocks decreased by 75 metric tons.

Storage Costs

Storing precious metals costs money. Of these, the more expensive take up less space and correspondingly silver takes up more room.

Precious Metal	**Approximate Number of Troy Ounces of Precious Metal worth U.S. $1 million***
Gold	2,180 oz.
Platinum	2,180 oz.
Palladium	6,160 oz.
Silver	68,000 oz.

*Fall, 1983 price average.

Storage charges vary: For example, 25 U.S. cents per ounce of silver per year or

0.5 per cent of the market value for the silver per year.

8.4 GOVERNMENT REFINED SILVER STOCKS IN THE WESTERN WORLD

	1980 (metric tons)
U.S.A.	
G.S.A., 1982 (Strategic Stockpile) unchanged since 1970	4,276
Treasury, 1982, virtually the same as 1976	1,141
India	2,146
Mexico (140 tons added in 1983)	373
Italy, unchanged since 1970	295
Afghanistan	258
Switzerland	183
Saudi Arabia	148
Nepal	140
Greece, unchanged since 1970	112
Japan	109
France, unchanged since 1970	106
Belgium	83
Philippines	77
Finland	76
Taiwan, virtually unchanged since 1970	62
Others	415
Total, including sundries	10,000

Sources: J. Aron; Handy and Harman; T.P. Mohide

8.5 INDIA AND THE EAST

Exports to China and India, including modern Pakistan and Bangla Desh

For centuries, the British, Portuguese and French bought tea, spices, silks and periods of peace from Indian potentates for the only thing those rulers desired — silver bullion, coins and gifts.

England had to spend about 30 million pounds sterling between 1733 and 1766 on silver bullion to cover its purchases of spices, silks etc. from India and the Far East. Asia wanted silver, not European goods.

Silk, pepper, spices, drugs and pearls could only be obtained from the Far East by payment in silver or sometimes gold.

8.5.1 CHINA

"Silver is Blood"

Many historians have described China as a "suction pump" for the world's silver supply.

The passionate desire for silver in China caused them to say in their perhaps imperfect Spanish to the merchants of the fabulous Spanish Manila galleon era, 1565 — 1815 A.D., "plata sa sangre", "silver is blood". China has never had a large mine production of silver. After about 1850, Mexico-minted Spanish silver dollars became the principal currency of the Yangtze valley and the main Chinese ports.

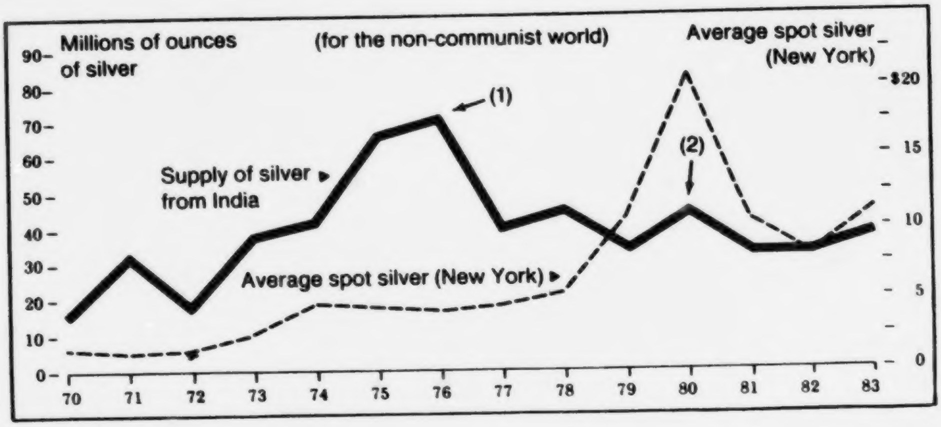
A large proportion of the silver mined in the world in the 1910's, 1920's and 1930's was exported to India and China. The average sent to those countries during the period 1910 through 1924 was 2,700 metric tons a year.

The former method of using silver in China is of interest. Traders carried on their business in silver dollars, (Hong Kong, Maria Theresa, Mexican and other kinds), and also used lumps of silver called "sycee", about the size and shape of a woman's foot bound and crippled by agelong custom, now happily in large measure discarded. But the lumps were not all of the same weight or of the same fineness, the latter being ascertained by the streak or mark which the lump makes on a piece of porcelain. The exchange was made by weight, and the unit of weight was a "tael". To further complicate the transaction, the tael varied from one province to another, so that the striking of a balance was a matter for experts, which Chinese merchants doubtless were. Several efforts have been made by successive Chinese reforming governments to substitute a more modern method, but custom persists.

The People's Republic of China may have a government stock of up to 7,800 metric tons of silver. However, private hoards of silver, usually coins, may be much larger. Some say that in 1980 alone, some U.S. $120 million of old silver coins were smuggled out of China. (China was the last country to abandon the silver standard for its currency.)

China is said to be quietly accumulating silver for the government stockpile.

THE SUPPLY OF SILVER FROM INDIA



1) Supplies from India for 1975 and 1976 were 50 per cent greater than the supply in 1974 — but prices were lower.

2) Supply from India for 1980. The price of silver had doubled and redoubled. But the weather was fine; there was no famine; emergency money was not needed; so exports from India were normal.

Source: Silver and Gold Report.

8.5.2 INDIA

In India, silver has long been used for trading purposes. The habit of hoarding has prevailed in India from time immemorial. The peasants have memories for traditions or invasions by more warlike peoples, and of the robbery and plunder which accompanied them. By burying their silver in the earth, or decorating their women with bangles and necklaces, they are ready to flee before an invader, carrying their silver with them. The peasants continue to hoard, although of late years the more prosperous have shown a disposition to convert their savings into gold instead of silver. Thus China and India, with their populations numbered in the hundreds of millions, are the ultimate and greatest potential markets for silver.

The Indian government stock of silver amounts to 2,100 metric tons.

India has only a small mine output of silver, incidentally, about 19 metric tons a year from Hindustan Zinc. Virtually all silver there today was imported over several centuries.

In India, to this day, even the poorest peasant hoards silver. A Hindu woman is allowed by her faith to possess only what she can wear on her person and so a majority adorn themselves with a variety of silver ornaments and jewellery as their total personal wealth. The husband has no claim on it. Official decrees peg silver in India at below the world price. Cheap silver is the reserve against hard times and old age, rather than pensions. But the greater part of the silver in India is in religious artifacts, objets d'art etc.

The people of the Indian sub-continent hold from 115,000 up to perhaps 140,000 to 155,000 metric tons of metallic silver, or some fifteen percent or so of the world's theoretical total supply. The lowest estimate for India and Pakistan is 70,000 tons. 115,000 tons is about the equivalent of some 10 years of total world consumption of silver.

The supply of silver to the Western world from India is apparently triggered more by emergencies such as droughts and famines than by higher silver prices in the West. India's crops were affected by drought in 1982, but with a good monsoon, the harvest improved in 1983. 1984 may be better.

Varying amounts of this hoard come onto the world market each year mainly through Dubai in the Persian Gulf. In 1980 and 1981, probably 778 and 1,000 metric tons of silver respectively left India, perhaps only 900 tons in 1981. However, in 1980 and 1981, Dubai exported 1,182 tons of silver, to Europe, mainly smuggled from India, so the figures may be lower. Silver exports from India probably increased in 1983 by 438 metric tons over 1982 to 660 metric tons, although the export of silver has been illegal since 1979. Exports of gold to India — partly a counterpart to the smuggling of silver out of India — were excellent in 1983. In the opposite direction, Dubai merchants supply gold, which some Indian brides buy.

Including amounts going to domestic consumption in India, these ancient stocks of silver contributed about 1,455 metric tons to the non-communist world in 1983 and 1,038 metric tons in 1982. That is quite a drawdown. Compare the level of total U.S. industrial consumption of silver in 1982 of 3,800 tons.

India began domestic production of silver nitrate for photographic purposes and this may take up about 60 metric tons of silver a year.

Total domestic consumption of silver in India is probably 600 to 800 tons a year. It may have been 900 tons in 1983.

The poor harvest of 1982 probably forced peasants to sell some of their hoarded silver to make up for the reduced grain supplies.

The population of India, as distinct from Pakistan, Bangla Desh (Bengal), Sri Lanka (Ceylon) and Burma, has risen by some 75 million people since British rule ended and a further vast population increase is expected.

Bombay and Calcutta will each have about 17 million people in 2000, but the population of those two cities will jump to an estimated 20-30 million each by the year 2025.

India (without Pakistan, Bangla Desh etc.) should grow from about 746 million in 1984 to 1.2 billion in 2000 and 1.4 billion in 2025.

This means that, as the hoard of silver there, accumulated over several centuries, is slowly drawn down, less and less silver will be available there per capita, as time goes on.

Chapter 9 Refining of Silver

Gold and silver production in the last 10 years has been greatly increased by the development and improvement of cyanide heap leaching methods. Using cyanide to separate precious metals from waste rock is an old technique practiced for a century but it has only been within the last 15 years that the method has been improved so that it could be used on high tonnage, low-grade deposits.

9.1 MELTERS AND ASSAYERS

9.2 SOME MAJOR PRIMARY SILVER REFINERIES

Canada

Ontario

Agnico, Cobalt, Ontario
Inco Ltd., Port Colborne
Royal Canadian Mint, Ottawa, Ontario
Johnson Matthey, Brampton
Kidd Creek Mines, Timmins
Handy & Harman of Canada, Toronto
Williams Gold Refining of Canada, Fort Erie

Quebec

Canadian Copper Refiners (Noranda)
Mines Gaspe, Murdochville

British Columbia

Cominco (Canadian Pacific), Trail
Teck Corporation

Manitoba

Hudson Bay Mining & Smelting

Australia	**Refinery Location**	**Metals Produced**
Broken Hill Associated Smelters	Port Pirie	Silver, Gold, etc.
Johnson Matthey Australia	Kogarah	Silver, Gold, Platinum
Electrolytic Refining U Smelting	Port Kembla	Silver
Mount Isa Mines	Mount Isa, Queensland	Silver
Belgium		
Metallurgie Hoboken-Overpelt	Hoboken	Precious Metals
Johnson Matthey & Pauwels		Silver, Gold, etc.
Bolivia		
Empresa Nacional de Fundiciones (ENAF)	Karachipampa	Silver, Lead, etc.

Brazil	**Refinery Location**	**Metals Produced**
Cia. de Perquisa de Recursos Minerais (CPRM)	Porto Allegre	Silver, Gold, etc.
Caraiba Metais	Camacari	Silver
Sdade Paulista de Metais	Mineracao Boquira	Silver, Lead
Degussa S.A.	Guarulhos	Silver
Chile		
Enami, Empresa Nacional de Mineria	Las Ventanas	Silver
Empresa Minera de Mantos Blancos	Antofagasta	Silver
Denmark		
Paul Bergsoe & Son	Glostrup	Silver
El Salvador		
Minas San Cristobal	San Cristobal	Silver, Gold
United Kingdom		
Britannia Lead	Britannia Works	Silver, Lead, etc.
Capper Pass	Melton	Precious Metals
Johnson Matthey	Brimsdown	Precious Metals
Finland		
Outokumpu Oy		Precious Metals
France		
Mines et Produits Chimiques de Salsigne	La Combe-du-Sault	Silver
Cie. des Metaux Precieux (Engelhard)	Ivry etc.	Silver
Penarroya S.A.	Noyelles-Godault	Silver, Lead, etc.
Cie. Royale Asturienne	Auby-lez-Douai	Silver
Comptoir Lyon-Alemand Louyot	Noisy-le-Sec	Silver
West Germany		
W.C. Heraeus	Hanau	Silver
Berzelius	Duisburg	Silver, Lead
Degussa	Hanau-Wolfgang	Silver
Norddeutsche Affinerie	Hamburg	Silver
Preussag-Boliden	Nordenham	Silver, Lead

	Refinery Location	Metals Produced
India		
Arora Matthey	Tollygunge, Calcutta	Silver, Gold, Platinum
National Refinery Pvt.	Bombay	Silver
Hindustan Copper	Khetri	Silver
Hindustan Zinc	Tundoo	Silver
Hutti Gold Mines	Hutti	Silver, Gold
Indonesia		
P.T. Aneka Tambang	Pengolahan Dan Pemurnian Logam Mulia	Silver, Gold, etc.
Italy		
Metalli Preciosi	Milan	Silver
Chimet	Arezzo	Silver
Vieri	Pove del Grappa	Silver
Vimet	Vicenza	Silver
Mario Villa	Milan	Silver
Japan		
Dowa Mining	Kosaka	Silver, Gold, etc.
Furukawa	Tochigi, Ashio	Silver, Gold, etc.
Hashimoto Precious Metal	Osaka	Silver
Ishifuku Metal	Soka City	Silver
Mitsubishi	Osaka	Silver, Gold, etc.
Mitsui Mining & Smelting	Takehara	Silver
Nippon Mining	Hitachi	Precious Metals
Sumitomo	Niihama	Silver, Gold, etc.
Toho Zinc	Chigirishima	Silver, Gold, etc.
Tokuriki Honten	Tokyo; Fukami	Silver
Yokohama Metal	Sagamihara City	Silver
Mexico		
Industrial Minera Mexico	Monterrey	Silver, Gold, etc.
Cia. Minera de Cananea	Cananea, Sonora	Silver
La Negra y Anexas	Queretaro	Silver, Lead, Zinc
Met-Mex Penoles	Torreon, Coahuila	Silver, Gold, Lead
Cia. de Real del Monte y Pachuca	Pachuca	Silver

	Refinery Location	Metals Produced
Norway		
A/S Nogusra	Oslo	Silver
Peru		
Empresa Minero del Centro del Peru (Centromin)	La Oroya	Silver, Gold, etc.
Philippines		
Apex Mining	Masara	Silver, Gold
China (Taiwan)		
Taiwan Metal Mining	Chin-Que-Shih	Silver, Gold, etc.
South Africa		
Rand Refinery	Johannesburg	Silver, Gold
Impala Platinum	Johannesburg	Silver, Gold
Assayers, Refiners & Engineers	Johannesburg	Silver, Gold, etc.
Blyvooruitzicht	Blyvooruitzicht	Silver
East Rand Propr.	East Rand, Transvaal	Silver
Spain		
S.A. G. y A. Figueroa	Madrid	Silver
Sdad Minera y Metalurgica de Penarroya-Espana	Cartagena	Silver
Sdad Espanola de Metales Preciosos	Madrid	Silver
Rio Tinto Minera	Minas de Rio Tinto, Huelva	Silver
Sweden		
Boliden Metall	Ronnskar	Silver
Johnson Matthey AB	Stockholm	Silver
Nordiska Affineriet Ana	Helsingborg	Silver
Switzerland		
Metaux Precieux, Metalor	Neuchatel	Silver
U.S.A.		
Western States Refining, Veta Grande Companies	California	Silver

	Refinery Location	Metals Produced
U.S.A. (Continued)		
Sunshine Mining	Idaho	Silver
Bunker Limited Partnership	Idaho	Silver, Gold
Hecla, with Ranchers	Miami, Arizona	Silver
Amax Lead and Zinc	Illinois	Silver, Zinc etc.
Gemini Refining	California	Silver
Simmons Refining	Illinois	Precious Metals
States Smelting & Refining	Lima, Ohio	Silver
St. Joe	Missouri	Silver, Lead etc.
Joseph Behr & Sons	Rockford, Illinois	Silver
Yankee Fork Operation U.S. Antimony Corporation	Montana	Silver, Gold
Cyrus Northumberland	Nevada	Silver, Gold
Round Mountain, Smoky Valley, Copper Range	Nevada	Silver, Gold
U.S. Metals (USMR), Carteret	New Jersey	Precious Metals
Johnson Matthey,	Salt Lake City, Utah	Silver, Gold etc.
Escalante Mine, Redco Silver	Utah	Silver, Gold
Cincinatti Gold & Siver Refining	Cincinatti, Ohio	Silver
Handy & Harman	Fairfield, Connecticut	Silver
Asarco	Amarillo, Texas	Silver
Duval (Pennzoil)	Sierrita, Arizona	Silver
Engelhard	Newark, New Jersey	Silver
Williams Gold Refining	Buffalo, New York	Silver
Pease & Curren	Warwick, Rhode Island	Silver
Phelps Dodge	El Paso, Texas	Silver
United Refining & Smelting	Franklin Park, Illinois	Silver
United States Metals Refining	Carteret, New Jersey	Silver

EXECUTIVE SUMMARY

> "A word fitly spoken is like apples of gold in pictures of silver."

1. Silver is a precious metal that has retained its value over extraordinarily long periods of time. This will continue to be the case in future decades, just as it has been in the last 6,000 years.
2. Silver has a more universal appeal than the other much more expensive precious metals such as gold, platinum and rhodium.
3. Silver is greatly desired for personal adornment in jewellery, as well as for the protection of personal savings by storing silver in the form of bars, coins etc — as an ultimate and indestructible store of wealth that will not diminish as most paper currencies do.
4. Silver, with its quite unique properties, has a very wide and growing range of uses in industry, in medicine, in dentistry, in space vehicles, in coinage, in mirrors, in photography and X-ray films, in tableware and electronics.
5. Silver has no competitors in 90 per cent of its uses and its price is relatively low.
6. Silver is the most plentiful of the precious metals recovered from the earth, but it is nevertheless a relatively scarce metal. NO COUNTRY HAS GREATER RESERVES OF SILVER IN ORE IN THE GROUND THAN CANADA.
7. Silver has from ancient times had a very special allure for women.
8. Silver is one of the most important metals mined in Ontario and in Canada in terms of aggregate value, ($335 million in Ontario in 1980), and in the provision of jobs.
9. Silver is now worth about six times the price it sold for less than twenty years ago.
10. The pre-1967 Canadian silver 25-cent piece is now worth about Can.$1.48 because of its silver content. The Canadian paper 1-dollar bill is thus now worth far less than four Canadian pre-1967 25-cent silver pieces, which are now worth about C.$6.00. In other words, the paper one-dollar bill now has a purchasing power that is far below the paper dollar of 1966, while silver, however, has more than held its value (in the silver in the surviving pre-1967 coins).
11. Canada was, in recent years, the free world's largest mine producer of silver and now ranks third.
12. Ontario has usually been the leading silver producer among the Provinces and although this position slipped in the last few years, it is expected that Ontario will return to the top slot in the near future.
13. Ontario is therefore a major world factor in silver supply.
14. The making of the world silver price each trading day is exceedingly complex and no single country can take government action to control the price and neither can groups of countries. In recent years, the U.S. government has tried twice and failed. Peru has failed and so on.
15. Most of the world's newly mined silver comes as a byproduct or coproduct of base metal or gold mining. Such mines adjust their output levels to the ups and downs of base metal or gold prices, not the silver price. A minority of the world's mines have silver as their main output. The percentage of these in the U.S.A. is particularly high.
16. Recovery of refined silver metal from scrap sources is at a very high level in the advanced industrial countries.
17. For about the last thirty years, the amount of silver consumed each year in industry, medicine and the arts has greatly exceeded annual world mine output of silver.
18. The shortfall or gap in supplies has been made up year after year by deliveries of metal recovered from scrap and by drawdowns from stocks held by companies and particularly governments, thus concealing the apparent inability of mine production to meet the world demand for silver which will continue for many years to come.
19. The bulk of these huge stocks have been sold off in the last twenty five years, so we are now

approaching a situation where such silver stock sales will terminate or slow down to a trickle and from then on basically only mine output, plus recoveries from scrap, will be available to attempt to satisfy the growing world demand for silver in the next few years.

20. Remaining surface stocks of refined bullion silver are formidable, but a large part of these stocks will not come onto the market until the silver price is extremely high.

21. This developing constriction of supply in the face of rising demand can only result in much higher prices for silver eventually. As the silver price rises, holders of the remaining silver will be reluctant to sell, hoping for even higher prices.

22. Until that point is reached the short-term outlook for the silver price understandably is unexciting, but, as stated, the longer term will produce a much higher price level for silver.

23. This rise in price will be a great advantage to Ontario in future years, not only for the higher corporate revenue and tax revenue, but because high silver prices will encourage the reopening of old mines and the opening of some new ones and the expansion of certain existing mines, plus an increase in mineral exploration, creating even more spending power from more jobs in Ontario and Canada.

POLICY PROPOSALS

1. The government of Ontario should encourage the federal government, when economically feasible, to reintroduce a small percentage of domestically produced silver into circulating Canadian coinage or into Canadian banknotes on security fibres.
2. The government of Ontario should encourage the federal government to mint a special collector's coin with a face value of five dollars in sterling silver. These would not go into general circulation, but would be purchased and saved by individuals in many countries.
3. The government of Ontario should continue to encourage the minting by private mints and by the Royal Canadian Mint in Ottawa, Ontario, of silver medallions for sale to collectors to commemorate a wide range of events (e.g. royal visits, significant provincial anniversaries of historical events, completion of major construction projects such as the twinning of the Burlington Skyway), as well as some medallions on famous Ontarians and Canadians.
4. The government of Ontario should consider instituting a system of awards in silver to go to worthy persons, recognizing their contribution to the welfare of the province in a public, industrial or private capacity. See Chapter 6 — Awards and Incentives.

The government of Ontario should consider the award of silver medallions to that wide range of civil servants which includes doctors, nurses, airline pilots, bus and subway drivers etc. in recognition of particularly meritorious service, modelled on such incentive and recognition award systems that have provided excellent results in various industries in Canada and other countries over many years, at low cost.

"APPENDIX I"

EARLY ONTARIO SILVER MINES

(adapted from Mining in
Ontario by Thomas W. Gibson,
Director of the Bureau of Mines,
Ontario Government,
Printed and Published by the Printer
to the King's Most Excellent Majesty, 1937)

Lake Superior Mines

There have been two distinct eras of silver mining in the province in widely separated districts. Both have been strongly tinged with romance. The first began in the early part of the last century on the north shore of Lake Superior in the general neighbourhood of Port Arthur in the northwest of Ontario. Prospectors looking for copper, perhaps hoping for large bodies of ore such as were then being worked at Bruce Mines, found numerous veins containing native copper or copper sulphide accompanied by a minor proportion of silver. Perhaps the largest of such veins was that at the Prince's mine, discovered as far back as 1846 or 1847. The British American Mining Company worked the vein, which in places was 14½ feet wide, and at a depth of 90 feet a bunch of ore, several hundred pounds in weight, was encountered containing native (naturally occurring) silver. This yielded on an average three and one half parts of silver to every one hundred pounds of rock, together with a little gold. But the mass was soon exhausted, and further exploration proving fruitless, the mine was abandoned.

In 1866 Peter McKellar located a vein at Thunder Bay with a predominant content of silver, partly in the native form and partly as argentite. Considerable work was done on the mine and a quantity of ore was raised and milled, but operations were discontinued in 1874. The Shuniah or Duncan mine was found in 1867 the vein containing bunches of ore in a gangue of calc-spar with barren ground between. Some quite rich ore was obtained assaying in bulk *2,000 troy ounces of silver per ton* and also more or less concentrating rock of lower grade. The enclosing formation was the Animikie, but when the shaft penetrated the underlying Archean rocks, the silver disappeared. The Beck or Silver Harbour mine, discovered in *1870*, contained a brecciated vein about 5 feet thick, mostly of white granular quartz. It produced a quantity of silver, but values were lost entirely when the workings reached the older rocks. The vein in 3A mine, discovered in the winter of 1869-70, was 18½ inches to 2 feet in width, mostly quartz with a little calcite. It carried silver in the native state in small and large patches associated with sulphur and nickel, the latter assaying in one sample 25 per cent. Workings ceased about 1877.

The Epic Story of Silver Islet

The early regulations of the government with regard to the area of mining locations were, compared to modern ideas, generous to a fault. A mining location was required to be two miles in front by five miles in width, comprising an area of 6,400 acres. In 1856 a mining company had obtained from the Crown sixteen of these locations fronting at intervals on the north and northeast shores of Lake Superior, comprising in all 99,498 acres. The conditions required the grantee "to commence and *bona fide* carry on mining operations within a period of eighteen months", under penalty of forfeiture of the lands. But the company did not comply with the conditions, neither did the government exact the penalty. The grant reserved all mines of gold and silver and imposed a royalty varying from 2 to 10 per cent of the value of the ore extracted. In, as we may suppose, its anxiety to start things moving, the government abandoned the reservations of gold and silver, repealed the royalties, and forgave one-half of the purchase money of 80 cents per acre. The only offset on the part of the government was to levy a tax of two cents per acre on all lands granted previous to 1868.

All restrictions having been removed and facing an annual tax of approximately $3,140 the company apparently deemed it advisable to examine their lands for possible deposits of mineral. Their interest was probably quickened by the discovery of silver made by the McKellar brothers and others on the north shore of Lake Superior. The task of examination the company committed to Thomas MacFarlane, a well known geologist and civil engineer. MacFarlane and his party set out in the apring of 1868 and cruised the locations one by one. On the Jarvis location they found a vein of silver, upon which considerable work was afterwards done and a quantity of silver recovered. Eventually the party arrived at the Woods location. He determined to make a complete study of the location and set his assistant, Gerald C. Brown, to survey the shore-line.

While engaged in planting pickets on the islands in Lake Superior fronting the location, Brown landed on the tiny rock about the size of a ballroom to which Macfarlane afterwards gave the name of Silver Islet and here he noticed a vein carrying galena. Macfarlane thereupon visited the spot himself and put three of his men to work. On the north shore of the islet there was a vein having a width of 20 feet, which on the south divided into two branches, each seven to eight feet wide.

On the 10th of July the first metallic silver was noticed by John Morgan, one of the exploring party, at the water's edge on the east or hanging side of the west branch of the vein, in the form of small nuggets. A single blast was sufficient to detach all the vein rock carrying ore above the surface of the water, but the ore was traced some distance out into the lake, where instead of scattered nuggets of native silver, large patches of veinstone rich in galena were visible, intermixed with small particles and large nuggets of silver. The thickness of the rich part of the vein varied from a few inches to two feet and by working in the icy water with crowbars some rich pieces of ore were broken off.

On the 15th of July three packages of the best specimens were shipped from Fort William, Thunder Bay, altogether 1,336 lbs. of ore having been obtained. This shipment was carefully weighed and sampled in the following December. Assays by Professor Chapman of Toronto, Dr. Hayes of Boston and Macfarlane himself, gave an average of *2,087 ounces Troy per long ton.*

Next year explorations were resumed on the rock, but winds and waves, together with the extreme coldness of the water, proved great hindrances. Nevertheless, by working with tongs and long-handled shovels in two to four feet of water, the party was able to raise and ship 46 half-barrels of good ore, weighing 9,455 lbs. valued by Macfarlane on the basis of his assays at $6,751. Such results indicated a mine and amply justified further development. A shaft house and sleeping and dining rooms for the men were erected and strong barriers of two-inch plank built to protect them from the furious gales and sweeping winds of Lake Superior. Inflowing water slowed up work in the shaft and the contracted area of the mine severely hampered operations. Weather conditions, however, had their compensations for when the winter set in, the frozen surface of the lake provided solid footing for the men who managed to raise some nine tons more of the ore. The total quantity of ore recovered up to this time was 28,073 lbs. which realized after being smelted, the sum of $23,115. The mining company in March, 1870 sold not only the Woods tract, but all of its other locations, now 18 in number, to a new group, the price realized being $225,000.

The new company formed the Ontario Mineral Lands Company and selected Captain William B. Frue as manager, who at once set to work in September of that year.

Frue was a man of remarkable quality and is worthy of some words of mention. Not only was he a skilled and experienced mine superintendent, but he seems to have been of heroic calibre.

During the six years beginning with 1870 production of silver from the mine amounted to 1,561,882 fine ounces, but output was lessening year by year, due to unfavourable changes in the vein as the lower workings were reached.

The company got into financial difficulties and facing a heavy deficit, sold all its holdings to a new concern known as the Silver Islet Consolidated Mining and Lands Company, with a capitalization of $1,000,000.

The new company met with wonderful success, far exceeding their expectations. The first three levels were explored and much silver recovered from them. The mine, which had been allowed to fill up as far as the third level, was dewatered and work was carried on from the fourth to the tenth level. The results are thus described in the company's report for 1878: "Silver of unparallelled riches was found in the winzes, in the drifts and in the stopes and rich stamp-mill rock abounded in all workings, the vein north of the shaft being particularly productive".

The year 1878 closed with an output of silver estimated at 724,632 ounces, of which 551,111 ounces was obtained from "packing ore" (i.e. one rich enough to be put up and shipped to the smelter in small packages) and 170,521 ounces from stamp mill concentrates. This estimate, however, proved to be too large, for the amount realized was $137,022 less than the value originally placed on the shipment.

Frue had been succeeded as superintendent by Richard Trethewey, who decided to divert the vertical shaft to an incline following the line of the diorite dike, associated with which the ery rich ore of the earlier workings had been found. He carried it down to a further depth of 414 feet and drifts started at the bottom showed the vein to present highly promising conditions. Some very rich ore was encountered in a south drift. The hope was that the chimney of ore would again be tapped at the junction of the diorite and the slates, but although fugitive bunches of ore were met with, the mine failed to respond to expectations. Evidently the end was approaching. Minerals which frequently accompanied the silver, such as blende, galena, pyrite, cobalt and nickel were found, but the silver was absent.

Notwithstanding financial and mining difficulties, the work was continued until February, 1884. It was still intended to carry on, but a cargo of coal in charge of a drunken ship's captain had failed to arrive before the close of navigation and no course was open but to allow the mine to fill with water and cease operations.

The total production of the mine in ounces cannot be precisely stated, the records being incomplete, but the entire value is given at $3,500,000. At the average price of silver during the 16-year period of operations say $1.15 per ounce, this would represent a total output of about 3,044,000 fine ounces. To this may be added 16,769 ounces obtained during 1921 and 1922 by the Islet Exploration Company which removed a quantity of rich ore from the roof of the mine.

The main production was from two very rich bonanzas, one of which was completely worked out in 1874, yielding over two million dollars. In shape this mass of ore resembled an irregular pear and consisted of arborescent silver. The second bonanza was found on the third level in 1878. It was remarkable for its width (5 feet solid across the breast) and for the occurrence of two previously unknown compounds of silver, huntilite and animikite. This deposit was phenomenal in its structure, the middle of the fourth level being sunk literally through solid silver, the metal projecting boldly from the four walls of the winze. In the breast it stood out in great arborescent masses in the shape of hooks and spikes and in gnarled, drawn out and twisted bunches. The width of the deposit was over 10 feet and including the accompanying stamp rock, it yielded about 800,00 ounces of silver.

Probably nowhere, or at any rate nowhere in Canada, had mining been carried on under conditions so difficult as at Silver Islet, the area of which before enlargement by protective works, was no larger than a good-sized ballroom. Wind and water conspired to prevent an invasion of the tiny spot.

Silver Mountain

In 1884 Oliver Daunais found rich silver ore on an elevation in the township of McIntyre afterwards named Silver Mountain. The ore occurred in a fissure about a mile long and on this vein two mines were opened, one at each end, called respectively East End and West End and the West End Silver Mountain, which on being opened up continued to produce freely, but in later stages spasmodically. The mine was closed in 1903, but work was resumed at a later date, and when rich pockets were found in sufficient number a carload of ore was shipped away.

No reliable statistics of the production from these or other mines on the North Shore can now be had, but men who professed themselves to have been conversant with the leading producers during the time of their operation have estimated their output as follows:—

Silver Mountain	$ 600,000
Beaver	550,000
Badger and Porcupine	300,000
Rabbit Mountain	50,000
Jarvis Mining Company	40,000
3A and Beck	10,000
Total	$1,550,000

It is evident that these figures cannot be accepted as accurate since it is known that the output of Silver Islet alone had a value of $3,500,000.

Rabbit Mountain

Silver mining received a fresh impetus in 1888 with the finding of the Rabbit Mountain group of mines. The discovery was attributed to Oliver Daunais, one of the best known prospectors of the day, but Dr. Robert Bell gives the credit for the original discovery to an Indian called Tchiatang, Daunais' father-in-law.

The group included the Rabbit Mountain, Beaver, Porcupine, Badger, Silver Creek and other mines, the first two being the most important. At the Rabbit Mountain mine the vein was 4 to 6 feet in thickness, though much wider in places. It had a length of 800 feet and the surface showing of native silver and argentite created much excitement. Most of the ore recovered was from a depth of about 100 feet but rich material was also obtained at a depth of 160 feet producing concentrates which averaged $1,000 per ton, but which occasionally ran as high as $4,000.

Beaver Mine

At the Beaver mine the main vein had an average width of about 4 feet, the silver occurring chiefly as argentite or in nuggets, or in sheet and leaf forms. In the overlying trap the vein was solid and well defined and when it reached the argillite rock some good ore was obtained, but on sinking further the vein became small and irregular. At greater depth it again changed in character, becoming once more strong and definite and yielding a body of very rich ore. The mine was sold and the new owners erected a concentrator having a capacity of 30 tons per day, to treat the low grade rock. In August, 1887, at Port Arthur, Thunder Bay newspaper stated: "The total value of the products of the Beaver for the past two and one-half months in smelting ore and concentrates was $93,000. This may be relied upon as authentic".

Romance of Cobalt, Ontario

It has been said that all that is necessary to uncover a new mineral area in Ontario is to build a railway into the wilderness. Witness the Canadian Pacific Railway, which in 1883 had progressed much of its way to the Pacific ocean from as far away as the spot on which now stands the city of Sudbury, Ontario. The right-of-way ran through a small hill and disclosed the presence of copper ore, which was subsequently developed as the Murray mine, the earliest of the great group of mines now producing many thousands of tons of copper, a sizeable amount of silver and gold and a large part of the world's nickel every year. So it was with the wonderful silver field of Cobalt, Ontario.

The Ontario Government had determined to connect older Ontario with the extensive tracts of fertile land north of Lake Timiskaming and so constructed the Temiskaming and Northern Ontario Railway. In 1903 the line was being laid down some four miles west of that lake and south of the township of Bucke, on the 7th of August, two lumbermen, James H. McKinley and Ernest J. Darragh, were cruising the Booth limits for tie-timber and rounding the southeast end of Long Lake (renamed Cobalt Lake) their eyes were caught by the gleam of some flakes, apparently of metal. On examining the spot more carefully, they picked up some loose pieces of rock, which appeared to be unusually heavy and in washing some of the gravel from the beach they found more of these flakes or leaves. Testing them, prospector-like, with their teeth, they found the flakes to retain their tooth-marks and moreover they could bend them. Sending their samples to Dr. Milton Hersey, a well-known assayer, they received the astonishing news that what they had submitted was native silver and that the samples assayed carried *an astonishing 4,000 ounces of silver to the ton.*

They applied at once to the Government for a mining lease, which they received in due course, but did little or nothing on the claim until the following spring, when some further prospecting was done and a small plant erected. The claim was dubbed by the surveyor "J.B. 1", the first mining claim in the new field. Later the lease was merged into a grant in fee simple, the grantees being the two partners, together with Robert Gorman and William Anderson. On the claim was developed the rich and well-known mine named after the discoverers.

The second find was made by Alfred LaRose, a blacksmith who worked his forge beside the grade of the new railway, about a mile north of the McKinley-Darragh claims. His work did not keep him very busy and with the consent of his foreman, Duncan McMartin he was accustomed in his leisure hours to poke about in the rocks nearby. Having had a little experience in prospecting, he thought he might find mineral. LaRose tells the story:

"One evening I found a float, a piece as big as my hand, with little sharp points all over it. I say nothing, but come back and the next night I take a pick and look for the vein. The second evening I found it: you can see it on the side of the hill now. Then I go to the boss, Duncan McMartin and say: "Boss I have a good thing, come with me, you give me a good show". He say: "Pull a gun on me if I don't." Then I show him the vein and we stake two claims, one in his name and another in mine. We had one-half a share in each."

It is to be noted that LaRose in his application to the Department of Mines describes his discovery as one of copper.

T.W. Gibson, Director of the Bureau of Mines of Ontario happened to be in the neighbourhood at the time and was shown a sample of the mineral by Arthur Ferland, keeper of the Metabanick Hotel, Haileybury. Ferland regarded it as copper ore, owning to its reddish colour, but did not care to part with the sample, so Gibson was given another specimen. But what they were the prospectors did not know. They were silver and rich silver at that. Nickel there was, but it was a minor constituent. The specimens received represented high-class ore.

Pieces of native silver as large as stove-lids or cannonballs lay on the ground, as well as cobalt bloom, (an arsenide of cobalt, of a beautiful peach-blossom colour) and niccolite. The indications were for a silver field of very unusual richness and probably of considerable extent. Carefully collected specimens were taken of the rich silver ores and also of cobalt and nickel. This unique collection was to be seen in the show cases of the Ontario Department of Mines, Toronto.

On the 21st of October, 1903, Tom Hebert discovered the first vein on what afterwards became the property of the Nipissing Mining Company and assisted by Arthur Ferland and R.A. Galbraith, an engineer on the railway construction, staked it out. A few days later, Hebert discovered what came to be known as the "Little Silver" vein, out of which over $500,000 worth of silver was extracted. Hebert sold his claim to Ellis P. Earle who with others incorporated the Nipissing Mining Company with a nominal capital of $250,000.

Apparently the last discovery in 1903 was made in November by Neil King, who located the vein on the site of the future O'Brien mine.

The spring of 1904 did not witness much animation in the Cobalt field. But when it was learned later in the summer, that ore was actually being shipped out netting many thousand dollars for a carload, a genuine rush set in, which increased in volume and intensity during 1905 and 1906 and by the end of latter year most of the finds in Cobalt camp proper had been made.

Nevertheless there were a few who early heeded the becomings of fortune. One of these was William G. Trethewey, whose Celtic Cornish name and ancestry naturally associated him with mining and who in fact had been a prospector in British Columbia. Hearing from Hersey of these remarkable finds, Trethewey made his way to Haileybury early in May of 1904. He pitched his tent beside Cobalt Lake and at once set about prospecting. He had wonderful success.

On the second day he located a silver vein and gives a vivid and amusing picture of a prospector's anxiety to make sure of a new-made and valuable find: "My first anxiety was to find if anyone had been there before me, but after careful examination concluded that it was a virgin discovery. I had no axe with me and there were fellows down at camp who would have made a wild rush up there if they had known and I might have lost my mine. So I hid it as well as I could by throwing sticks and moss over the rock where I had shipped it and came down to the camp and quietly had my tea. I then started out with my axe on my shoulder slowly enough until I got out of sight of the camp and then I only hit the ground at the high places. I squared a post, put the number of my licence and my name on it, planted it firmly over the discovery and make a witness tree, then I started along the bluff a little farther and discovered the Coniagas mine. (co — cobalt, ni — nickel, ag — silver, as — arsenic).

I knew by the indications that there was a vein, but it was dark and I was afraid of getting caught in the woods. I saw Professor Miller that night and told him I had made a find and asked him to say nothing. He visited the property with me the next morning and re-examined it throughly to see if there were any signs of prior discovery, but there were none."

Early shipments from the Trethewey mine, consisting of slabs of native metal stripped off the walls of the vein, like boards from a barn, were exceedingly rich. Aleck Longwell shared Trethewey's tent and after assisting him to stake the Trethewey and Coniagas claims, went on himself and located a deposit afterwards known as the Buffalo mine, in the staking out of which he was assisted by Colonel R.W. Leonard. The discovery on the Buffalo was a small vein of smaltite, showing much arsenic but little silver. In the spring of 1906 the Buffalo Mines Limited was incorporated and the mine proved to be a valuable and profitable one. Funds for developing the mine came mostly from people in the city in New York state after which the mine was named.

After the first period of incredulity had passed regarding the silver discoveries at Cobalt and it became evident that a virgin field of unusual richness had been opened for exploitation, a tremendous wave of interest and excitement arose. Indeed, it is difficult for a later generation to realize how greatly the public mind was intrigued. The political and mining atmosphere, especially in northern Ontario, became charged as with electricity. Prospectors, promotors, mining men of all descriptions and eager novices, rushed to the scene and in a trice the whole township of Coleman was thickly studded with the corner posts of mining claims.

Never in the history of mining in Ontario has prospecting been so intensive as at Cobalt. Every nook and cranny in the rock, however small, was examined with the minutest care, for it might contain a king's ransom. The overburden of soil was heavy and trenches many feet deep were necessary in order to get access to the rock surface. Hydraulic monitors were resorted to for the same purpose. On a claim of 40 acres half a dozen parties might be seen at work at the same time, for a real discovery of valuable mineral had to be made in order to secure a claim. Prospectors without money, but with a vein which showed calcite and silver, had no difficulty in selling, or in raising funds for development. Much money came from the United States and many of the mines were brought into being by American funds, as with the Nipissing, Kerr Lake, Buffalo, Temiskaming, Penn-Canadian, Wettlaufer and other properties.

Mining begain in 1904 with the opening up of the Trethewey, LaRose, Nipissing and McKinley-Darragh properties. Naturally, being on the surface, the richest ores were the first to be mined. The quantity raised and shipped in this year was 158 tons, the silver content of which was 206,875 ounces, having a value of $111,887. Of the other constituents of the ore, nickel accounted for 14 tons, worth $3,467, cobalt for 16 tons, valued at $19,960 and arsenic 72 tons, worth $903. The total value of these initial shipments was $136,217, or at the rate of $862 per ton.

The rise of the camp was rapid. All the requisites for speedy development were present,

1) the richest of ores,
2) a railway (T & N.O) running through the centre of the camp,
3) abundance of wood for fuel and mine timbers,
4) plenty of labour,
5) law and order well represented by the newly created Ontario Provincial Police

and were ideal conditions for the young mining field.

The number of mines shipping ore had meantime steadily increased up to 16 and the quantity of ore shipped in 1905 amounted to 2,144 tons, having a total value of $1,473,196, of which silver accounted for $1,366,503. New mines were O'Brien, Kerr Lake, Foster, Coniagas, University, Buffalo, Temiskaming & Hudson Bay and Drummond. In 1906, 5,335 tons of ore were raised, the total value being $3,764,113. Production increased year by year by approximately three million ounces per annum, until in 1912 the returns amounted to $17,805,397. In 1911 the apogee of production was reached, with a total of 31,507,791 ounces of silver.

The Crown-Reserve Mining Company, a predecessor of Agnico-Eagle, Cobalt, reported high grade ore that ran close to *5,000 ounces of silver per ton* in 1909 and produced 624 metric tons of silver from 1908 to the early 1930's.

The Decline of the Cobalt Camp

A steady though not a rapid decline then set in, the flattening of the downward curve proceeding at a much slower pace than the rise of the upward one. Output was sustained by the finding of new deposits in the original field and also of new fields. South Lorrain and Casey townships began to yield in 1908, Gowganda in 1910. Casey was not a large camp but South Lorrain and Gowganda, while smaller in area than Cobalt, were quite on a par with it in richness.

It takes a good mining camp a long time to die and the decline of Cobalt was more gradual than the rise. World War I came in 1914 and the miners of Cobalt enlisted almost to a man. Efficient labour became scarce, commodities rose in price and mining had to be carried on under many difficulties. Production began to fall off, slowly at first, then more rapidly. The prosperous times at Cobalt were largely over.

Rich Silver Samples

In order to realize the extraordinary richness of the veins in the Cobalt camp, mention may be made of the following "high spots".

A piece of float embedded in the surface of the Gem claim near Giroux Lake, weighing 1,640 pounds avoirdupois contained by calculation 9,715 ounces troy. This float had probably been transported from a point some 3,000 feet distant. It constituted the entire mine, for nothing else of value was found on the claim.

Another nugget from Block 32, Gillies Limit, weighed 1,424 pounds and contained by calculation 11,001 fine ounces of silver, or 754 pounds avoirdupois.

A section of a vein in the Keeley mine, South Lorrain, weighing 4,402 pounds, contained 24,211 ounces, or 1,660 pounds avoirdupois of silver. The purchase price at 64½ cents per ounce, amounted to $15,616. Known as the "Keeley Nugget", this was one of the notable exhibits made by the Ontario government at the British Empire Exhibition, held in Wembley in 1924. It was the largest individual block of silver ore of such richness ever mined in Northern Ontario.

A block of calcite from the Crown Reserve mine enclosed a sheet of essentially native silver one-half to one inch in thickness and contained 2,464.33 ounces fine.

The above specimens were displayed in the main corridor of the Parliament Buildings, Toronto.

The Woods vein, north face, in the Keeley mine, averaged 10 inches in width and assayed 8,000 to 14,800 ounces of silver per ton.

The Carson vein in the Crown Reserve mine, 17 to 34 inches in width, 286 feet in length and 150 feet in depth, yielded in high grade ore 9,211,270 ounces of silver. This gives an average production per cubic foot of the vein area of 214 ounces, probably the largest production from any vein section comparable in size. The extension of this vein in the Big Chamber of the Kerr Lake mine adjoining, produced 1,483,401 ounces.

Vein 490 in the Nipissing mine, from an ore shoot 600 feet long, produced 800 to 1,000 ounces per ton from a 5-inch width.

In the City of Cobalt property, worked by the Mining Corporation of Canada, a vein system known as Nos. 24-32, yielded about 12 million ounces of silver.

The main vein at LaRose had an ore shoot of 850 feet long, which yielded 700 to 1,000 ounces per ton and in richer places ran from 3,000 to 14,000 ounces per ton.

On vein No. 9 at the Lawson mine, an ore shoot 70 feet long and 5 inches wide, carried ore assaying 2,000 to 3,000 ounces per ton; a smaller shoot assayed 9,656 ounces per ton.

At the Temiskaming mine in May 1907, 52,000 pounds of ore gave a return of 123,786 ounces of silver and in the following August 82,452 pounds yielded 185,178 ounces. In 1912, hand-sorted high grade ore, weighing 376 tons, showed an average assay value of 4,423 ounces per ton and one carload from the 499-foot level, weighing 25 tons, contained a total of 202,000 ounces and netted $117,962.00.

A large quantity of silver was recovered from lake bottoms. Cobalt lake was dewatered and veins found in the bed were worked to much advantage. This was also the case at Kerr Lake. It took nearly two years to empty the latter and a total of over a billion gallons of mud and water had to be removed. At Cart lake, the Seneca Superior Company worked the bed without ridding it of the water and obtained 5,639,993 ounces of silver. It may be mentioned also that from the strip of land forming the bed of the Cobalt T. & N.O. railway station-grounds, the Right-of-Way Mining Company obtained 2,961,353 ounces of silver.

One item that may be of interest is a list of key surnames in Canadian prospecting discovery and mine-making history, particularly silver and gold mines, at the end of the last century and in the early part of this is studded with a particularly high proportion of Irish surnames such as O'Brien, O'Brian, Sullivan, O'Neil, O'Donnell, O'Meara, McAnenny, McCaffery, McConnel, McCrea, McManus, McMartin, McNeely, McTague, McVeigh, McWatters, McMahon, MacMahon, Mallen, Callinan, Casey, Coffey, Coghlan, Connell, Coleman, Costello, Daly, Delahanty, Dwyer, Farlie, Fennell, Finnegan, Flanagan, Flynn, Hackett, Hearne, Howey, Keeley, Kennedy, Logan, Quinn and Ryan.

In Ontario — in silver mine-finding and development alone — in the same period, there are quite a number of other Celtic names such as the Welsh, Cornish, Irish and Scottish surnames McKellar, Duncan, McIntyre, Macfarlane, Hayes, Morgan, Gallagher, Murray, McKinley, Rose, Darragh, McMartin, Galbraith, Kennedy, Timmins, Dunlap, Drummond, Casey, Keeley, Blair, Coleman, McLeod, the Crawfords, Gillies, MacLaren, as well some of the names listed under Canada in the previous paragraph, such as the Cornish Tretheweys.

HISTORY OF THE HAILEYBURY SCHOOL OF MINES

Following the discoveries of rich silver deposits at Cobalt, which were made as a result of the building of the Ontario government's 1903 railroad to the north of Lake Timiskaming, special part-time classes in mining subjects were established in 1912 in connection with the Haileybury High School. Full-time classes were soon organized and in 1917 a building known as "The Mill" was built.

It was equipped by the management of the mines of Northern Ontario for the treatment of gold and silver ores according to the prevailing practices. The related classroom studies were conducted in the High School. By 1929 the accommodations had becomes inadequate and plans for a new building were prepared. A modern structure designed especially for studies in mining subjects was completed in 1931.

For a number of years, the school was operated successfully as the Haileybury Mining School under the Advisory Vocational Committee of the Haileybury High School Board, but with the advent of World War II there was a considerable drop in enrolment and in 1943 the Haileybury Board decided to close the school for cost reasons. Soon, however, concern was expressed about the lack of opportunity for mining training for young men in the northern municipalities. This led to representations to the Royal Ontario Mining Commission which in October of 1943 had undertaken the study of various matters pertaining to the welfare of Northern Ontario and the mining industry, including the educational policies.

In 1944, on the recommendation of the Mining Commission, the plant and equipment of the Haileybury School of Mines were acquired by the

Ontario Provincial Government which passed legislation to operate the school as Ontario's first Provincial Technical Institute under the name "The Provincial Institute of Mining".

Courses of study in mining subjects at a high level were planned and considerable new equipment was purchased. The opening of the Institute was in September, 1945. Since that time the Institute has enjoyed outstanding success as a high-level Technological Institute.

To accommodate increasing enrolments, the plant was enlarged in 1959. The extension provided a large ore dressing laboratory, more classroom and office space, a common room and a library. Also, the older part of the building was completely modernized.

Early in 1967, with the launching of the concept of "Colleges of Applied Arts and Technology", the Institute was incorporated into the Northern CAAT which has Ontario campuses at Kirkland Lake and South Porcupine in addition to Haileybury.

Further increases in enrolment called for expansion and modernization of both physical plant and equipment and the introduction of new courses in the disciplines of Instrumentation and of Maintenance Technology. The new plant provides six new laboratories, two lecture rooms, a large library, gymnasium, staff offices and a lounge, a common room and office areas for student associations. A number of built-in mineral display cabinets now form an attractive feature of the new college building.

APPENDIX II

METALS BEFORE 1,000 A.D. — SIMPLIFIED DATE CHART

METALS ARE USED TO SYMBOLISE THE STAGES OF GROWTH AND PROGRESS OF CIVILIZATION. "GOLD (AND SILVER) AND CIVILIZATION WAX AND WANE TOGETHER" — HISTORIAN WILL DURANT.

It is said that THE HISTORY OF GOLD AND SILVER IS THE HISTORY OF THE WORLD. Certainly, the quest for silver and gold and the uses that have been made of them is, in a very real sense, the history of nations.

COPPER AND BRONZE AGES

Bronze is a man-made alloy of *copper* and *tin* or *arsenic*. Alloying *copper* with *tin* gives greater strength to the weapons and tools so made. The *Copper* Age came first and then later on, when the benefits of the addition of *tin* or *arsenic* became known, the *Bronze* Age.

Stage 1) The Copper Age

The first age of metals, (WHICH INCLUDED *SILVER* AND *GOLD* AND *LEAD*)

(up to 3500 or 3000 B.C. The Later Copper Age is considered by some to date from 2500 B.C.)

7,000 B.C.	Early experiments with copper ores in Anatolia, Asia Minor, now Turkey.
6,500 B.C.	Use of *copper* known in Asia Minor, (now Turkey), and in Southeast Europe, in what is now known as Bulgaria and Romania, which share the lower Danube. The earliest known exploitation of *metals* in Europe, at Karanovo, Bulgaria and Gumelnitsa, Romania.
	Beads of *lead* of this date and later have been found at Catal Huyuk, Turkey. (Native *lead* is rare, just as native *silver* occurring in nature in the pure metallic state is quite rare.)
before 6,000 B.C.	Knowledge of farming appears in Southeast Europe, i.e. Bulgaria, Crete and Greece. Agriculture begins to replace hunting. The easily worked loess soils along the river Danube, running eastward from what is now Southern Germany through Austria, Czechoslovakia, Hungary, Yugoslavia, Bulgaria, Romania and the U.S.S.R. border in temperate Europe, were helpful. Man's development in Europe advanced.
c.6,000 B.C.	Probable date of the first human settlement in *gold*- and *silver*-rich *Ireland*.
by 5,600 B.C.	Neolithic, (stone tools and weapons), communities established in Italy.
5,200 B.C.	*Copper* is used in trade in the Mediterranean area.
5,000 B.C.	BEGINNING OF *LONG SUMMERS AND MILD WINTERS*, WORLD-WIDE. The loess soils along the river Rhine, which originates in what is now Switzerland and runs north through Western Germany, eastern France and Holland, were easily worked. Britain becomes an island — land connection severed by melting ice sheets.
5,000 to 5,300 B.C.	Egyptian calendar regulated by the sun and moon: 360 days, 12 months of 30 days each. Earliest cities in Mesopotamia, (carbon test dated).
5,000–4,000 B.C.	Effective techniques of smelting were developed and it first became possible to cast objects like axes and mace-heads.
4,700–4,800 B.C.	Oldest known megalithic or massive stone monumental passage chamber monument (megalithic = large stones) built by man still stands in Brittany, NW France, in Western Europe at Kercado, (a Celtic name).

4,500 B.C.	Farmers in Eastern Europe learned how to smelt copper and gold — see 4,000 B.C.
	Metalsmiths were extracting *silver* and *lead* from ores. In a charcoal fire, *silver* chloride ore is easily converted to *silver* bullion.
	Bronze casting begins in the Middle East.
	Gold mined from shallow deposits in Egypt. The first mention of *gold* in recorded history on the Sakkara *gold* reliefs in Egypt, showing goldsmiths at work. The word for *silver* was K-S-F or Kesef and for *gold* K-T-M or Ketem.
4,000 B.C.	Megalithic tomb-builders all along the lands of the Atlantic seaboard, (from Spain to Denmark) in Western Europe, such as the Breton passage graves and the Carnac complex. See 4,700 B.C. (These are *far older than the Pyramids of 2,700 B.C.); in Ireland* too by 3,000 B.C. near the Cliffs of Moher. Most were built between c.3,500 and 2,500 B.C. The oldest of these megaliths are rarely more than one hundred miles from the ocean.
	Vast unfaced blocks were somehow piled one upon another to create these megalithic monuments, which became quite elaborate in Ireland and Spain. Draught animals were used for this and for four-wheeled carts.
before 4,000 B.C.	The world's oldest treasure of *gold* objects made by man — uncovered in 1972 in Varna, Bulgarian Black Sea coast in Eastern EUROPE. The pieces all older than 3,500 B.C.; 2,000 *solid gold* pieces totalling 5.5 kilograms, including cast *gold* objects.
after 4,000 B.C.	Southern and Western France in Western Europe were occupied by humans, (still neolithic).
	Major *copper* and *iron* mines worked at Rudna Glava, Majdanpek, Yugoslavia. Similar mine workings of this period were at Ai Bunar, Bulgaria, Rio Tinto in Spain and at Mount Gabriel, Ireland.
	Copper smelted and tempered in Sumeria, now Southern Iraq. *Bronze* produced there not long after.
4,000	*Copper alloys* used by Egyptians and Sumerians.
	Sumerian writing, on clay tablets, inveted. It shows around 2,000 pictographic signs. The Sumerian word for *silver* was KUBABBAR.
4,000 to 3,000 B.C.	In Eastern Asia Minor, the predecessors of the Hittites produced *silver* in volume in this millenium.
3,900–3,600 B.C.	Some of the oldest examples of smelted copper are from the period of about 3,900-3,600 B.C. at Tepe Yahya in Eastern Iran.
3,600 B.C.	*Bronze* artifacts of this period found in northern Thailand, (in the early 1980's), centuries before comparable Middle East finds.
Prior to 3,500 B.C.	*Silver*/Gold price ratio by weight was 1 or less of *silver* to 1 of gold.
3,500 B.C.	2.5 to 3 ounces of *silver* equalled 1 ounce of *gold* in value, (*Gold/silver* price ratio). Code of Menes, Egypt.
3,500 onwards	*Silver* metal-working. *Silver* output in Asia Minor; smiths (*metals*) and masons become craftsmen. *Bronze* Age in Bohemia (now in Czechoslovakia), Central Europe.

3,500– 3,000 B.C.	A *bronze* reamer, a tool for enlarging or shaping a hole, of this date, found near Antioch, Syria contains 2.73 per cent *nickel.*
c. 3,400 B.C.	The wheel originates in Sumer (now Southern Iraq).
no later than 3,400 B.C.	The Egyptian language recorded in hieroglyphic script. (Egyptian in its oldest form is clearly related to Semitic).
3,200 B.C. or	Gold/*silver* price ratio was 2.5:1 or 3.1. *Gold* was two and a half or three times as valuable as *silver* in Egypt under Narmer.
3,500 B.C. 3,100 B.C.	Crete, Southern Europe — Early Minoan Age civilization; copper, *silver*, and gold in use — also pictorial writing. The ancient word for *silver* in Crete was SA-YA.

n.b. China never had what might be called a Copper Age. It appears that the country jumped almost directly from stone to Bronze. The same is true of Britain. In Japan, the development of iron may have preceded bronze.

Stage 2) The Bronze Age proper

by 3,000 B.C.	The first *bronze* developed by man consisted of *copper* and arsenic. The presence of arsenic in *copper* ore cuts down the absorption of the gases that make *copper* castings porous and ensures a much better product. Of course, the arsenical gases given off were pretty deadly for the metalsmiths. *Copper*-arsenic ores were widely available throughout the Middle East.
	There was no *tin* in the Middle East for the later *bronze (copper-tin)*. It had to come from distant Armenia or remote Bohemia/Hungary.
	Bronze, (an alloy of *copper* and *tin*), widely used for tools in Eastern Europe and the East.
	Bronze-using and stone-using peoples invade the Aegean area.
by 3,000 B.C.	*Tin* ores were being smelted, facilitating the production of *bronze*, an alloy of *tin* and *copper*, (or, earlier, arsenic and *copper*).
	Copper working spread in Europe.
	Farming communities had been established over most of the British Isles.
c. 3,000 B.C.	Northeast of the 700-foot sheer drop Cliffs of *Moher*, stretching for miles on the Atlantic Ocean, near Ballyvaughan, is the Portal Dolmen, an Irish megalithic burial monument of huge *limestone* slabs from 3,000 B.C. — only one of over 100 similar burial monuments in this area of Ireland at the most westerly end of Western Europe.
c. 3,000 B.C.	Man tames the horse on the Asiatic steppes.
	Use of *bronze* in Thailand.
c. 3,000 B.C.	Food was being produced in Denmark.
c. 3,000 B.C.	The town of Chur settled, in Eastern Switzerland, almost on the upper Rhine. (2,200 years older than Rome.) Chur is still vigorous there.
from about 3,000 B.C.	Some of the oldest *silver* artifacts presently known to us. Rulers in the Middle East were buried with objects of *silver*. *Silver* jewellery and other metal works were in full use in Asia Minor.

3,000 B.C.	Near East and Mesopotamian cities of Ebla near Aleppo, Syria and Mari on the Upper Euphrates traded on a basic gold ratio of 5 ounces of *silver* to one ounce of gold. Gold/*silver* price ratio 5:1. The Eblaite word for gold was "ku-tim" (Hebrew ketem or zahev) and for signet ring "hu-ta-mu" (Hebrew hotem-et). The Hebrews developed in Egypt from about 1,500 B.C.
	Massive megalithic passage grave monument at New Grange, Ireland aligned with rising sun at winter solstice.
3,000 to 2,501	Probable period of manufacture of the first *iron* objects. The price of iron in the Bronze Age was 1 iron to 40 *silver.* *Metal* pieces (or "coins") begin to replace barley as legal tender. *Metal* mirrors used in Egypt.
3,000 B.C.– 2,000 B.C.	Stonehenge megalithic monument begun in Southern Britain in Western Europe. Became a centre for religious worship.
2,900 B.C.	Craftsmen work *copper* in Upper Egypt.
2,900 B.C.	Iberian (Spain and Portugal) metalworkers in Western Europe *cast copper* and arsenical bronze tools.
2,850 B.C.	Date of a *silver* vase from Chaldea (now Southern Iraq).
2,800 B.C.	Approximate date of a solid gold bull, looking like a Texas Longhorn, found at Maikop in the Caucasus, U.S.S.R.
2,750 B.C.	Date of the fabulous hoard of *precious metal* treasure found at Ur, including bowls, flutes, lyres and headdresses of *silver* and jewellery of *silver* and *gold.*
	Date of gold headdress of Queen Puabi or Shub-Ad of Ur of the Chaldees, which can be seen today.
by 2,700 B.C.	Smiths had achieved temperatures high enough to melt *iron* efficiently.
c. 2,700 B.C.	The *gold/silver* price ratio was 1:9 in the Middle East. 1:9 in the time of Sargon of Akkad.
2,700 B.C.	Sumerian language now in cuneiform, (a system of wedge marks on *clay* tablets, which are then baked).
c. 2,700 B.C.	Pyramids begun in Egypt.
c. 2,590 B.C.	Great Pyramid built in Egypt. Remains of an Egyptian of about this date have perfectly preserved *gold* dental bridgework, the oldest known example of restorative dentistry.
from 2,500 B.C. to about 1,800 B.C.	European *metalworkers,* traders and merchants known as the Bell Beaker folk roamed Europe. They used *copper* but not *bronze.* They went as far as modern Poland and Scandinavia and also to Britain, probably the first metal workers there, (where they erected one of the early versions of Stonehenge).
2,500–1,500	The Early Bronze Age, according to certain scholars.
2,500– 2,000 B.C.	*Celts* overran Western Europe, including Southern Germany, according to many scholars. They learned to ride horses, used *iron* weapons and tools and were ruled mainly by the Druid priestly class. See c. 2,000 B.C.
	Metallurgically, the Middle East dropped out of the Bronze Age, owing to the exhaustion of the local tin deposits.

2,500 B.C.	A grave of this date, containing a polished stone axehead, was found at Linkardstown in Co. Carlow, Ireland.
	Silver ornaments and jewellery dating back to 2,500 B.C. have been found all over the Mediterranean area.
	The *silver-lead* ores at Hissarlik, near Troy, Asia Minor (Turkey) were worked.
	Early Minoan civilization clearly develops on Crete (Southern Europe), known to the Egyptians as Keftiu and later in the bible as Kaphtor. Three Early Minoan *silver* daggers from Kumasa and *silver* seals and ornaments survive from this age.
	The Ebla civilization flourished in what is now Syria. Balkan smiths in Europe discovered the superiority of *bronze.*
	The Uneticians of Bohemia exploited copper, gold and *tin.*
2,500 onwards	Egyptian ships import *gold* from Africa.
2,487 to 2,473 B.C.	Revelation in 1959 of two pre-Hittite Royal graves of about 2,487 — 2,473 B.C. at Dorak, near the Sea of Marmora, northwest Turkey, which yielded a *silver* dagger almost 12 inches long, two *silver* lance heads, a *silver* diadem with pendants, *silver* ear-pendants, a bracelet made of *silver* wire with electrum (gold-silver alloy) rosettes and two *silver* bracelets.
c.2,400 B.C.	Date of treasure hoard containing *silver, gold* and *copper* objects from the second level of the city of Troy, Asia Minor.
by 2,400 B.C.	The Iberian communities of Alentejo and Algarve, i.e. the southern half of modern Portugal, and of Almeria, southeast Spain, in Western Europe, were skilful in the extraction, *alloying* and casting of *copper.*
2,400 B.C.	Assur, capital of the Assyrians, was trading with the West. The Assyrian word for *silver* was SARPU. Compare the present Russian word for *silver,* serebro.
2,300 B.C.	Unetician metallurgists exploit Bohemian tin to make bronze.
	Copper metallurgy spreads, along with clay "breakers", in Western Europe and the British Isles.
	The conqueror Naram Sin of Akkad boasted of capturing Ebla and burning its palace.
c.2,200 B.C.	Middle Minoan civilization. Minoan palace societies begin on Crete (Europe's first writing, linear in pen and ink, begins to emerge).
2,200 B.C.	Indo-European-speaking Hittites, (later leaders in iron and *silver* output), occupy nearby Asia Minor, (Turkey).
	Silver figurines of their goddesses recovered in modern times.
	(The Hittites join together in one kingdom/Empire later, 1650 B.C.).
	Indo-European speaking people, (early Greeks), appear in Greece for the first time.
2,150 B.C.	The Semitic Akkadian empire collapses.
2,100 to 2,000 B.C. (or 1,900 to 1,400)	Stonehenge IIIa (Stonehenge proper) construction started. (Completed, with rebuilding, c.1,600 B.C.)

before
2,000 B.C.

The Treasure hoard of Priam, of *silver* and gold objects found at Troy, Asia Minor (now Turkey) is not likely to be later than 2,000 B.C.

Intentional additions of both *silver* and copper were made to gold in Europe and the Middle East. Until then, of course, gold alloys containing considerable proportions of *silver* that occur in nature as "electrum" were in use.

c.2,000 B.C.

The first people to practice *metallurgy* in Ireland, (probably the people who preceded and later merged with the "Beaker folk"). Ireland achieves pre-eminence in the *Bronze* Age. Produces *bronze* well before *Britain.* British and Breton metalsmiths mine *tin* for *bronze* production, probably for sale to the Irish. Use of *bronze* in Western Europe. Ireland had become one of the chief mining and industrial centres of Early Bronze Age Europe. Ireland a major source of *gold.* The sources of most *gold* artifacts produced during the Bronze Age in Western Europe that survive today are:

Ireland (over 1,000 pieces),
Britain (about 5,000 pieces),
France (around 400 pieces),
Spain and Portugal and Northern and Central Europe.

The output of *lavish gold* jewellery pieces of various types was virtually confined to Ireland in those days.

A pair of *gold* decorative discs made there at this time — on view today — deserves special mention.

IN ANOTHER OF THE INDO-EUROPEAN PEOPLE DEVELOPMENTS, THE CELTS, with a separate Celtic language, (and Celto-Ligurians), in numerous tribes, EMERGED IN CENTRAL AND WESTERN EUROPE: (equated with the "Bell-beaker" folk); users of *metal* weapons and tools.

"The Indo-European speaking Celts emerge as a separate people in Central Europe." (M. Dillon and N. Chadwick)

Eastern Asia Minor was exporting *silver* to Assyria. A colony of Mesopotamian merchants resided in Asia Minor to handle this trade.

2,000 B.C.

Scribes in Mesopotamia (Iraq) made calculations in a system based on the number 60. (It survives in our 60 minute hour and our 360 degree circle). See 360-day year in Egypt, 5,000-4,001 B.C.

2,000 B.C.

Iron artifacts appear in Thailand at Non Nok Tha, (much earlier than in China and India).

Further Greek-speaking tribes arrive in mainland Greece. They brought to Crete a new word for *silver,* ARGYROS, (which they had borrowed from another source), which we still use in our technical literature in English.

c.2,000 B.C.

An elegant *silver* cup from Gournia, Crete, dates from this period. Start of techniques to separate gold from *silver.* The modern refining process to do this was not developed until 1802 by D'Arcet. Small pieces of *gold* jewellery of this date found at Kerouaren in Plouhinec, Morbihan, Brittany, France. The megaliths of Carnac and Locmariaquet are nearby.

c.2,000 to
c.1,800 B.C.

The first *Celtic* settlements in the British Isles?, (early *Bronze* Age). (M. Dillon and N. Chadwick.) See 2,500 B.C.

2,000 to
1,650 B.C.

In Crete, (now part of Greece), "Linear A" hieroglyphic script was in use. (This is still undeciphered.)

2,000 to 1,501	Bronze Age in Britain and in Western Europe. Mercury used in Egypt. Decimal system in Crete (Europe).
between 2,000 B.C. and 600 B.C.	The differentiation of the *Celtic* languages into two main groups, the more archaic Goidelic (Q-Celtic) of the "Beaker Folk", which was the parent of Irish and Scottish Gaelic, and the newer Brythonic (P-Celtic) of the "Urnfield" people, forebear of Welsh, Cornish and Breton, took place in the British Isles, as well as on the Continent. (M. Dillon and N. Chadwick.) In its two main forms, the *Celtic* language is still spoken by more than two million people in the 1980's. (An estimated 80 million people have some *Celtic* ancestry today).
2,000 to 1,000 B.C.	INCREASING DRYNESS OF THE CLIMATE IN EUROPE CULMINATED IN MASS MIGRATIONS AND HAD THE EFFECT OF ACCELERATING THE SHIFT FROM *BRONZE* TO *IRON*. The alphabetic principle (one sign represents one sound) invented in Canaan and adopted by the Phoenicians of Lebanon by 1,100 B.C. The Semitic Canaanites were ancestral to the Phoenicians. The Bronze Age iron-*silver* price exchange ratio was 1 iron to 40 *silver*. Iron was rare. Small amounts of *iron* were available from Anatolia, (Asia Minor), at a price of 40 times that of *silver* by weight.
1,894 B.C. (or 1,751 B.C.)	The Semitic Amorites founded a dynasty at Babylon, with *King Hammurapi, the great Law Codifier.* The *gold/silver* price ratio was 1:6 under Hammurapi of Babylon. Hammurapi speaks of *silver* with a value determined by the weight and quality of the metal.
down to c.1,800 B.C.	The Beaker folk had been completely assimilated by another European group whom we call "Ueticians" from the site of one of their hoards. From the Carpathians, they spread out to occupy the rich valleys of Bohemia, Moravia, Silesia, Saxony, Bavaria and the Rhineland. The Uetician smith understood how to smelt and cast *metals* and *alloys* such as *bronze* and was a specialist exempt from farm labour. They borrowed from Ireland the halberd — a king of dagger or knife at the end of a very long pole, a marvellous thrusting weapon. Ueticians were reaping grain with blades of *bronze* when Egyptians were still using stone sickles. Steady rise of the "Unetice" civilization, (in what is now Bohemia, Czechoslovakia and Lusatia (Lusatz), (see 3500 to 3001.) The word Bohemia itself is Celtic in origin. From this area came the Celtic, Italic, Venetian and Illyrian languages which have many elements in common. Venetian and Illyrian are now virtually extinct, but a form of Italic survives as part of its derivatives, Italian, Spanish, Romansch and other Latin type languages, such as Romanian.
1,800 B.C. 1,600 B.C.	A solid *gold* lunula (a flat neck-torc or collar) from this time survives today in Ireland.
c.1,700 B.C. (or as far back as 2,000)	Abraham used 400 *silver* shekel weight-pieces to buy a burial site for his wife Sarah from a Hittite clan, whose word for Shekel was Gín. (The Hittites spoke the oldest known Indo-European language).
c.1,650 B.C.	Use of bronze implements known in Ireland.
from 1,670 B.C.	The gold/*silver* price ratio ranged between 8.9 to 1 to 18 to 1.

1,650 B.C. onwards	The Indo-European Hittites of Asia Minor join together in a single kingdom and developed the West's first imperial government, ruling distant provinces. See 2,200 B.C. The name of their capital, Hattusas, was written with an ideogram signifying "*silver*". See 2,500 B.C. Asia Minor had *silver* output from about 3,500 B.C.
c.1,600 B.C.	Famous Mycenaean gold funeral mask from shaft graves of Greek princes.
	Young Joseph, grandson of Abraham, was sold by his brothers for 20 pieces of *silver.*
1,600 B.C.	Phonetic alphabet invented before 1,600. The first complete alphabet in script form was devised by the Ugarit people in West Syria. OUR OWN MODERN WEST EUROPEAN SCRIPT ULTIMATELY DERIVES FROM IT. It bridges the gap between Homer and the Bible.
by 1,600 B.C.	*Iron* was being made in Thailand (Siam) (and in India not long after).
1,600 B.C.	*Bronze*-working thrives on the plains of Pannonia (Hungary).
	"Linear B" script, (a form of Mycenaean Greek), in use in Crete and Greece, both in Europe.
	The Greeks borrowed from other languages their words for terms of navigation and fishery, plants and *metals,* (chrysos for *gold,* "argyros" for *silver,* chalkos for *copper,* kassiteros for *tin* etc.). We use these word roots in English in the technical literature of metals.
	Peak of the Bronze Age cultures on the Atlantic coasts of the European continent and on the southern coasts of Britain and Ireland.
	Megalithic monuments erected by man on the Balearic islands in the Mediterranean, a geologic extension of the Andalusian (Vandalusian) mountains of eastern Spain.

Stage 3) THE IRON AGE

(The Iron Age is a period during which *iron* generally comes into use for weapons and tools.) Our English word iron derives from the Celtic language.

During the Iron Age, *gold* and *silver* apparently became much scarcer than in the *Bronze* Age and were almost exclusively used for princes and chieftains and their women.

c.1,500 B.C.–1,200 B.C.	Efficient techniques, overcoming the difficulty of working *iron* and producing much larger quantities, were further developed in Asia Minor, (now Turkey), by the Chalybes, a tribe subject to the Hittites mentioned in the scriptural story of David the King and the story of Abraham.
by 1,500 B.C.	In Ireland, skills in metallurgy firmly established, producing *copper* weapons, *gold* ornaments etc. for home and for export.
	The Uneticians were the dominant people of Europe. See 1,800 B.C.
c.1,500 B.C.	Ideographic script in use in China. Megalithic monuments erected on islands of Majorca and Minorca in the Mediterranean. Destruction of Knossos, Crete, (Europe), and the Minoan civilization.
1,500 to 1,001 B.C.	the Pharaoh Tutankhamen's body embalmed and placed in a sarcophagus of wood and gold.
	Beginning of the true Iron Age in Syria and Palestine.

	The Phoenicians (Lebanon) import tin (to make bronze) from mines in southwest Britain, (Cornwall).
	Beginnings of the Bronze Age in Scandinavia.
after 1,500 B.C.	Bronze casting in China is the most advanced in the world.
1,500–1,200 B.C.	Date of superb Vulchitrun precious metals (gold and *silver*) Treasure hoard found in North Bulgaria. It is ancient Thracian art. Total weight 12.5 kg.
1,479 B.C.	Pharaoh Thutmose of Egypt led his chariots, which were faced in electrum (gold-*silver* alloy), to victory against the chariots of gold and of *silver* of Kadesh (Syria) at Megiddo. A vast quantity of gold and *silver* was seized.
c. 1,450 B.C.	Elaborate ceremonial *bronze* sculptures created by the Chinese.
c. 1,420 B.C.	Aryans invade India from the northwest.
c. 1,400 B.C.	Zenith of Ugarit civilization (now West Syria).
	A very ancient epic from the 1400-1200 B.C. period in Ugarit, has the following lines in which King Kret seeks Hurrai's hand in marriage: "What need have I for *silver* And yellow gold together with its place And eternal slaves Teams of three horses Chariots from the court of a handmaid's son But what is not in my house shalt thou give! Give me Lady Hurrai."
c. 1,400 B.C.	Use of *iron* in the Middle East.
1,400 B.C.	Urn burials in *Ireland*. See Urnfield under 1,390 B.C. and 1,000-750 B.C.
c. 1,390 B.C.	North of the Alps, from North Czechoslovakia to the Rhine, a post-Unetician culture had developed which is called Urnfield (or Proto-*Celtic*). It migrated mainly to the West and South West. The ancestors of the modern Germans and the original Anglo-Saxons, Slavs, Italians and *Celts* emerged from the original Urnfielders, it is believed.
	The mining of *copper* in *deep* shafts showed a high degree of technological skill.
1,350 B.C.	The superb *silver* cup of this date discovered at Enkomi, Cyprus, Europe. The ambassadors from Kefti and Keftiu, i.e. Cyprus and Crete, brought *silver* vases as gifts for the Egyptian king.
	Zenith of the Hittite *iron*-making and *silver*-mining civilization in Asia Minor, (modern Turkey).
	It is a surprising fact that one of the Indo-European languages of the Hittite Empire has a special affinity to *Celtic* and (Old) Italic and particularly to Gaelic *Irish*. (M. Dillon and N. Chadwick.) Where was the common origin, one wonders.
c. 1,300 B.C.	The largest sheet-gold object ever found in Britain, in Clwyd, is of this date, a shoulder covering of chased gold on a bronze framework lined inside with leather.
c. 1,300 (or 1,100) B.C.	Date of the oldest known plan of a *gold mine* (in Egypt). This "map" is now held in Turin, Italy.

1,300 B.C. (or 1,292 to 1,200)	Approximate date of the oppression of the Israelites under Pharaoh Rameses II, also dated as 1198-1166 B.C., and Exodus from Egypt. (The Israelites had *gold* with them, with which they made a *golden calf.*) See 1,250 B.C.
1,300– 1,150 B.C.	MAXIMUM DRY PERIOD (DROUGHTS) IN EUROPE, IN THE MIDDLE EAST AND CHINA.
	The great migrations in Europe during the thousand years before Christ, such as the migration southwards of Germanic speech peoples and of that westwards of the Celts, apparently began with major catastrophes in nature, including those which forced the inhabitants of the land around the North Sea into mass emigrations.
	These movements of desperate people had the result of contributing to the decline of Bronze Age civilization and to the adoption of Iron Age tools and weapons.
	Droughts and volcanic eruptions were part of this pattern. Droughts and the resulting starvation have frequently forced peoples to migrate and fight for new territory.
	North of the Alps, the climate has never since been as hot as it was before 1,500 B.C.

N.B. NOTE THE UPHEAVALS to 1,000 B.C. IN THE WESTERN MEDITERRANEAN AND RELATED AREAS AROUND 1,200 B.C., as follows:

1,250 B.C. through 1,150 B.C.	VOLCANIC ERUPTIONS IN SINAI, SICILY (AND ICELAND). MAXIMUM DRY PEAK REACHED IN CONTINUING DRY PERIODS (DROUGHTS) IN EUROPE, THE MIDDLE EAST AND CHINA.
by 1,250 B.C.	Assyria swallowed the Mitanni empire of the Hurrians.
1,250– 1,100 B.C.	The Trojan War, in Western Asia Minor, traditional date; Siege and Fall of Troy VI, (destroyed by Mycenaean Greeks under Agamemnon who used *bronze* weapons and chariots but no *iron* artifacts) and no horseback riding soldiers, or cavalry. *Silver* artifacts of this date excavated at Troy in the 19th century A.D. Some scholars think that it was not only the smile of Helen, but the magnetism of Troy's wealth in gold and *silver* that caused a thousand Greek ships to invade.
1,250 B.C.	Stepping up of the Central European mass migrations to the South, Morthwest and West.
	The Urnfield people continue to emerge in Central Europe. These energetic and inventive tribes are identified as the direct ancestors of the Hallstatt period of the *Celts* of Western Europe, of the Italic and Roman peoples, of the Slavs and of the Phrygians and Illyrians of the Balkans. They brought *bronze* tools and weapons to a much larger number of people. The Hallstatt Celts, the original Iron Age (iron-using) culture in Northern and Western Europe from about 1,000 B.C., were descendants of the Urnfield people.
by 1,250 B.C. or 1,200 B.C.	Moses' followers, who had migrated from Egypt in the Exodus into the desert, eventually entered Canaan (or Palestine) under Joshua. See 1,300 B.C.
c. 1,210 B.C.	flange twisted *gold* earrings from this period in Ireland survive to this day.
by 1,200 B.C.	Central Europe supplanted the Mediterranean area as the centre of world *metal*working.
c. 1,200– 1,104 B.C.	Dorians from the north, (n.b. mounted warriors with *iron* weapons) invade Greece, ousting the Mycenaeans, who had only *bronze* weapons and chariots.
(Queensbury	End of Greek Mycenaean civilization is fairly abrupt. (see 1,000-901 B.C.)

and Hammond est.)	Destruction of the Greek-organized Mediterranean trade in *tin* (vital for *bronze*). *Tin* had to be obtained from remote places like Cornwall (Britain), NW Spain, Bohemia, (now in Czechoslovakia), or Iran. *Copper* was easier to get, but *iron* was plentiful and cheap.
1,200 B.C. approx.	"Dark Age" began in Greece, (which lasted until about 700 B.C.). (There are few surviving written records in "mainland" Greece for these next 500 years.)
c.1,200 (or 1,190) B.C.	Destruction of the *iron*-pioneering and *silver*-mining Hittite empire of Anatolia, Central Asia Minor, (Turkey), and North Syria by unknown raiders — including perhaps Phrygians from Macedonia, N.W. Greece in Europe — and by internal rebellion. *Iron* workers disperse to various countries? Cyprus displaces Anatolia, Asia Minor, as the main source of copper.
c.1,200 B.C.	Phoenician sea traders from city-state ports in Lebanon take over some of the Greek Mediterranean trade.
1,200–1,100 B.C.	*Silver* was being produced (by the Iberian tribes) as early as the 12th-11th centuries B.C. on the slopes of Mount Salomon at Rio Tinto in Huelva province, in SW Spain. This is one of the conclusions reached in the early 1980's by a group of scientists working with the Institute for Archaeo-Metallurgical Studies at the University of London, England, in cooperation with the Universities of Seville and Madrid. See 2,400 B.C.
1,200–900 B.C.	(Queensbury and Herm estimates): further *Q-Celtic* or Goidelic-speaking *Celtic* Indo-European peoples, advanced into Britain. Goidelic is a main but older branch of the *Celtic* language. The word Goidel which we use in English is an adaptation into English of Gwyddel, which is the "Old British" (Welsh) name for the Irish people. The word Britain is itself *Celtic*, as are the names *London, Avon, Severn, Clyde,* Cornwall, Thames, Dover, Don (river), York, Leeds, orange, lance, whiskey, cardigan, Arthur, Guinevere, Lancelot, Galahad, Tristan, Isolde, Paris, Lyons, Verdun, Seine, Somme, Loire, Limoges, Limousin, (from which our word "limousine"), Orleans, Rhine, Ruhr, Vienna, Bologna, Milan, Turin, etc. All of these and many other place names in Europe are of *Celtic* origin. *Gold* armlets and a flanged *gold* torc for wearing around the neck from this period in Ireland still survive today.
1,200 (or 1,197–1,180 B.C.)	Egyptian records talk of "marauders from the sea" and "from Palestine".
1,200 (or 1,184 B.C.)	Alternative date estimate for the destruction of the city of Troy VI. See 1184 B.C. and 1250 B.C.
1,195 (or 1,180) B.C. approx.	Egyptians defeat the "Sea Peoples", (probably Greeks, Cretans, Philistines etc.) Today, very little is known of the Philistines, who gave their name to Palestine.
1,184 B.C.	One estimate of the fall of Troy to Agamemnon of Greece, after 9-year siege. See 1,250 B.C. Troy's defenders buried 9,000 gold and *silver* artifacts for safekeeping before the Greeks plundered the city.
1,115 B.C.	Magnetic needle (*iron*?) reputed in China.

1,115 B.C. onwards	Aramaic language of Damascus, (Syria), and of Palestine was Semitic. IT WAS THE EVERYDAY LANGUAGE THAT JESUS SPOKE. Simple alphabetic script, based on the Phoenician script.
1,100 B.C.	Phoenician merchants' alphabet script developed from the Canaanite alphabet — in Lebanon; successor to Ugarit script of 1,600 B.C. Origin of most alphabets in use today.
1,020	Saul first King of the Hebrews.
before 1,000 B.C.	Etruscans (not speaking an Indo-European language) settle in west central Italy; became leaders in *silver*, gold etc. mining and metalwork. Earliest radiocarbon dates for *iron* usage in India in Madhya Pradesh.
1,000 B.C. approx.	*Iron* used in Austria (by the energetic and inventive Celts).
1,000–700 B.C.	Greeks and/or the Phrygians begin to develop their form of writing — the alphabet symbols — from the Phoenician script from Lebanon in the Middle East, with additions for vowels. Alpha (for "a", Beta (for "b") (hence "alphabet") are Phoenician words, as are the bulk of the other Greek names for letters: gamma, kappa, delta etc. See 1,500 or 1,400 B.C. "Linear B", 800-700 B.C. and 775 B.C.
c.1,000 B.C.	David and Solomon kings in Israel, (approximately 1,011-925 B.C.) (Uriah the Hittite was possibly employed by Israel because of knowledge of production of the superior iron weapons).
	Bronze begins to be replaced by iron in Europe and the Middle East. Decline of Aegean Bronze Age civilization.
	ANOTHER EXTREME MAXIMUM DROUGHT IN EUROPE. SWISS LAKES SHRANK TO THEIR MINIMUM DEPTH.
	Droughts frequently force peoples to migrate and fight for new territory.
	Teutonic (Germanic) tribes start to settle Northern Europe.
	Silver was being mined in Greece and the Aegean islands. The *silver-lead* mines at Laurion (Laurium), at the southern tip of mainland Greece, were known at this date.
1,000–901 B.C.	Shortage of *tin* (for *bronze*) in Greece.
	Earliest use of *iron* in Greece, probably from Cyprus.
	Gold vessels and jewellery in use in Northern Europe.
1,000–750 B.C.	New Centres of innovation and new axes of power emerged in Europe.
	Celtic peoples of Urnfield origin now dominate much of continental Europe. See 1,250 B.C.
	The *Celtic "Hallstatt" Iron* Age Culture period begins, (the early local *Iron* Age in Western and Central Europe). Iron tools and weapons in use. (Influenced later by the Cimmerians and the Scythians, both Indo-European speaking nomadic lightly armed horsemen from the East; see 835 B.C.) The Celts were great lovers of gold and *silver*.
	The *Celts* were *THE FIRST WIDESPREAD EUROPEAN IRON-USING CIVILIZATION*.
	Some Celtic words which now form part of the English language are lance (the weapon) and the verb, to lance an abscess, car, carpentry, iron, piece, rich, fun, mine (to get metals) and ambassador, etc.

1,000–1 B.C.	A great increase in the population of Europe north of the Alps took place during this period of 1,000 years.
c.950 B.C.	Scandinavian *bronze* and *gold* industries flourish.
950 B.C.	The Canaanites of the Syrian coast, (called Phoenicians by the Greeks), successors to the Ugarit alphabet, which dates from 1,680 B.C., continue to spread the use of their version of the alphabet, developed by perhaps 1,100 B.C. The Aramaeans used this script and it became the standard form of writing within a few centuries, throughout the Assyrian and Persian empires.
950–900 B.C.	Carthage (Kart-Hadasht, Qart-Hadasht or "New Town"), near Tunis, North Africa, founded by the Semitic Phoenicians of Tyre, the port in Lebanon. See 236 B.C.
900 B.C. (or before 1,000)	More Etruscans, (with a non-Indo-European language) settled in, or conquered the natives of, West Central Italy. With their valuable *metal* output, a high civilization is achieved.
900–801 B.C.	Iron and steel production noted in Indo-Caucasian culture.
893 to 859 B.C.	Cavalry, (men with metal weapons, swords or bows and arrows on horseback — not chariots), used for the first time in "recorded" history, (by Ashur-Nars-Pal II, (Assur-nasir-apli II), of Assyria, now northern Iraq).
853 B.C.	A typical year for the payment by the Phoenicians of Lebanon, of the annual "Tribute of the seacoast" (large quantities of gold, *silver*, tin and copper) to the aggressive Assyrians.
c. 835 B.C.	Cimmerian, (Indo-European speaking), nomad horsemen come from the East and occupy the Crimean peninsula in the Black Sea, (now U.S.S.R.), and later invade Europe, where they were in contact with the Celts.
by 800 B.C.	The iron-using Celts had arrived in Galicia (Gallaeci tribe) Northwest Spain, whose customs, including bagpipes, still survive there. The use of *iron* had spread throughout Europe. *Silver* deposits at Rio Tinto, Southwest Spain, were extensively worked in the 8th and 7th centuries. Indo-European speaking Scythian armed nomad *horsemen* advanced from Central Asia into Eastern Europe and pursued some Cimmerians into Asia Minor. Scythians were famous for their rich *gold* jewellery and the skill of their mounted archers. Appearance in Europe of *bronze* horse-gear of Eastern types. The Indo-European speaking Tokharians were "the principal Scythian tribe". (Justin). (The Tokharians established a kingdom in Transoxania c. 130 B.C.) It is astonishing to read that "The Tokharian language, (really two), of East Turkestan, is most closely akin to *Celtic* and (Old) Italic". (M. Dillon and N. Chadwick). Tokharian is now extinct. Celtic is the basic language of the Ancient Britons, the Welsh, the Highland Scots, the Irish, the Cornish, the Manx, the Bretons and the Gauls.
800–700 B.C.	Spoked wheels and metal horseshoes in Europe (*Celtic* Halstatt *iron* culture). First *iron* utensils. Hesiod defines the classical ages: *Gold* (paradise-like) *Silver* (without God; godless)

Bronze (art and warfare)
Iron (heroic)

The Etruscans in north central Italy were the most advanced in civilized achievements, (such as metal mining and *metal working*), in Western Europe in this century. Greece begins to recover from the Dark Age. Trade with Middle East being restored.

c. 800–775 B.C. The Phrygians or the Greeks developed *the world's first true alphabet, i.e. a fully phonetic alphabetic script* out of the Phoenician non-vocalic (no vowels) consonontal alphabet sign system.

750 B.C. The Greeks recorded that the Phoenicians of Lebanon were master craftsmen, particularly in *metal* work and begin to import their goods in quantity. *Iron* in general use among the Hebrews and Syrians.

The metal-mining city-states of the Etruscans accumulate great wealth. There was an enormous foreign demand for the Etruscan *silver* and other metals.

Greek colonists settle in Southern Italy.

722 B.C. Sargon II, an Assyrian general, later King of Babylon, armed the formidable Assyrians with *iron* weapons.

c. 710 B.C. Fresh waves of mounted nomads appear in the Middle East as a new and powerful force. These included the skilled *metalworkers*, the Scythians, of Europoid physique, speaking Iranian languages.

708 B.C. Gold/*Silver* price ratio is 1:13.5 in Assyria, recorded in a cuneiform inscription.

701 B.C. Sennacherib of Assyria overwhelms the Judaean kingdom which paid in tribute 30 talents of gold and 800 talents of *silver* and other luxury items.

by 700 B.C. The price of iron relative to *silver* was 2,000 iron to 1 silver. That is a massive decline in price since the Bronze Age, when it was 1 iron to 40 *silver*. Emergence into written history of the iron-using Celts East of the Rhine (in what is now Bavaria and Bohemia) and of their clients, the Illyrians, North of the Alps, who later occupied what is now Northern Yugoslavia.

Iron-working further developed.

Advanced horsemanship learned by the Celts from the Cimmerians in Eastern Europe: see 835 B.C.

The Celts could now cover great distances at much increased speed.

Celts begin to arrive in Spain and France in greater numbers. Urnfield Celts overrun Catalonia (SE Spain). See 800 B.C.

Silver deposits at Rio Tinto, Southwest Spain were extensively worked in the 8th and 7th Centuries.

Celts in Austria etc. bury *iron* swords with their dead.

Iron swords and "wheeled wagon" graves in Bohemia (Czechoslovakia) and South Germany.

700 B.C. Metal-working, in *gold* and *bronze*, general in *Ireland*.

700–601 B.C. The world's first known "coins", (slugs, hallmarked) made of precious metals cast in Lydia, Asia Minor (Turkey) of *electrum*, a naturally occurring *gold-silver* alloy; a tortoise was the typical Lydian symbol on coins. (The world's first *metal* coins?) The

	Lydians may have been of Indo-European speaking Hittite origin. Lydia was not Greek. The beginnings of a market economy can be perceived.
	The Chinese had been using coins for centuries but their content remains uncertain because they used the world "chin" both for gold and metals in general. The Phoenician/Carthaginian hunger for *silver* and tin became very strong. Trade with the Spanish *copper, silver* and *gold* mines of the Iberian (Ebro river) tribes started by the Phoenicians was also sought by the Greeks.
	Two fine Phoenician *silver* dishes with elaborate decoration from this century have been found east of Rome.
	A *silver* cup of this century was found at Praeneste, Etruscan territory.
c. 700 B.C.	The Etruscans, speaking a non-Indo-European language, became powerful in North Central Italy. (They were important because of their very rich metal mines, producing *silver, gold, copper, iron,* etc.)
753 to 700 B.C.	A Latin outpost against the Etruscans to the north, called Rome, was founded on the then frontier, according to tradition. Rule by Etruscan kings ended in Rome in 509 B.C.
663 B.C.	*Iron* working introduced into Egypt by the Assyrians.
ca. 650 B.C.	First record of Spanish *silver* being acquired by the Greeks. *Iron* technology introduced in China.
612 B.C.	Babylonians, Scythians and Medes destroyed Nineveh, the Assyrian capital.
604 B.C.	Nebuchadrezzar II (of the Bible) made Babylon a magnificent city.
c. 600 B.C.	The Celts master the *casting* of *soft iron.* A *Celtic cast iron* ring still survives — found in Moravia, Czechoslovakia.
600 to 501 B.C.	Greeks gave credit to Theodorus of Samos with the invention of ore smelting and casting, (but smelting and casting skills were known in Europe thousands of years before). See 600 B.C. immediately above.
before 600 B.C.	The first Greek coins used. Greeks use iron money, (spits and skewers for roasting food), called drachma; (the name is now used for the modern Greek currency).
by 600 B.C.	The gold/*silver* price ratio was 1:12. It remained between that and 1:16 for centuries except in China where it was 1:6.
600 B.C.	Trade in *silver,* gold, copper etc. between Phocaean Greeks and the Western Celts, (S. France/E. Spain) began from MASSILIA (Marseille), where Greek settlers intermarried with the local Celts. Laurion *silver* mines again producing in this century. The technique of solid cast metal vessels and applied figures, both in *silver,* developed in Greece. More Celts speaking the Goidelic (Irish and later Scots variant of Celtic) arrive in Ireland (from Spain?).
	Germanic tribes with names, (the Alemanni, the Franks, the Saxons and the Thuringians), invade Western Europe.
600–400 B.C.	Appearance of *iron* tools and a complex *iron*-casting technology, based on *bronze*-casting techniques, in China.
594 B.C.	Solon of Athens arbitrarily cut the value of the *silver* drachma by 27 per cent.
589 B.C.	Babylonians destroyed Solomon's most holy temple in Jerusalem and carried off the *silver* and gold objects it contained. The Babylonian "talent" currency certainly contained *silver.*

by 560 B.C.	Now *Celtic* peoples were well established in both Scotland and *Ireland.*
560–546 B.C.	Greeks of Ionia in Asia Minor subjected to *silver*-rich Lydia.
c. 556 B.C.	After 556 B.C., Peisistratus of Athens obtained command of the *silver* mines of Mount Pangaeus in Northern Greece and later the silver mines of Laurium south of Athens as well. This *silver* output resulted in increasing the value of the Athenian *silver* tetradrachm coin.
before 550 B.C.	Greek colony of Selinus in Sicily (now Italy) issued *silver* coinage. The *silver* probably came from Spain.
c. 550 B.C.	Major new discovery of *silver* in *lead-silver* ores at Laurion, near Athens. Corn imported from what is now southern Russia by Athens was paid for in *silver* bullion in the 5th and 4th centuries.
	Temple of Diana, goddess of *silversmiths,* women and nature, second oldest of the Seven Wonders of the ancient world, erected at Ephesus, Asia Minor, now Turkey. The word Diana was used as a synonym for *silver,* just as we still say for another metal, in English, Mercury, the god's name, for quicksilver.
	Hecateus the Greek records that the two great towns of the Celts were Narbo (modern Narbonne, S. France) and Noreia (Noricum, Nyrax, Magdalensberg, near Klagenfurt in E. Austria).
	Rome may have developed into a city by this date.
547 B.C.	Croesus, King of *gold* and *silver* rich Lydia, was overthrown by the Persian ruler Kurush, or Cyrus the Great. He took Babylon in 538. See Daniel.
521–485 B.C.	Persian *gold* daric coins, weighing about 130 grains Troy, first issued in the reign of Darius, nephew of Cyrus, were the standard *gold* currency down to Philip II of Macedon. The Persian coins, including *silver* siglos, were modelled on the Lydian coins. *Silver* was the basis of the Persian imperial currency. Cyrus and Darius released the Jews and large quantities of the *silver* and gold objects in Babylon stolen from the holy temple in Jerusalem, which was now rebuilt. The 5,400 *silver* and gold vessels are listed in Ezra 1:9 to 11.
520 B.C.	The first stage of a general Celtic advance south into Italy.
509 B.C.	Foundation of the Republic of Rome as the Etruscan-origin Monarchy in Rome ends.
500 B.C.	Iron Age beginning in Britain.
c. 500 B.C.	Iron technology established at urban Meroë, Egypt.
	Iron tools entered China; Iron casting techniques were advanced, greatly assisting agriculture.
by 500 B.C.	The majority of the population of Western Europe was now *Celtic-speaking* with an *iron* culture. (A people is essentially a linguistic community.) Hundreds of *Celtic* place-names and river names have survived in France, Belgium, Britain, Ireland, Wales, Scotland, Cornwall, Portugal, Spain, Northern Italy, Germany, Switzerland, Austria, Hungary, Poland, Yugoslavia and Romania, as well as one in what is now Soviet territory. A large number of these Celtic place-names and river names are now found in Canada and the U.S.
500 B.C.	A new wave of *Celts* speaking the Brythonic P-Celtic (Welsh, Cornish and Breton) variant of the *Celtic* language arrive in the British Isles.

	Remarkably preserved body of a man of this period found in 1984 in a Cheshire, England bog. X-rays, cat scans, hair analysis, biochemical analyses, blood type tests, genetic make-up tests, radiocarbon dating, bone analysis will all be used to learn more about him. He was almost certainly a Celt.
	High point of *metal* rich Etruscan political power and civilization in Italy. From now on the Etruscans are forced further and further south by the *Celts.* Trade between Etruscans and the *Celts* to the north began in Northern Italy.
	Approximate date of the famous Thracian *silver* drinking cup, shaped like a horn, found at Bashova Mogila, Bulgaria.
	Gold/silver price ratio is 1:13 in Persia.
by 500 B.C. approx.	*Iron* had mainly superseded *bronze* for common use in Europe. The use of *iron* was dominant throughout the known world. The Chinese were using *cast iron.*
500–200 B.C.	Gradual southward migration of Gauls (*Celts*) into North Italy, as Etruscan power begins to decline. The Etruscans were no match for the massed onslaughts of the Celts. Mining of *silver* and *copper by the Illyrian, Thracian and Celtic populations of what is now Yugoslavia.*
500–400 B.C.	*Gold-silver* price ratio was 10:1 in Greece in the 5th Century. In Persia 13:1. Dominant position of Athens in the 5th Century due to its control of the two main sources of mined *silver.* The profits must have been very great.
489–480 B.C.	The discovery and further development of rich *silver* deposits, in *lead-silver* ore, at Maroneia at the state-owned silver mines at Laurion, Southern Greece, enabled Athens to build the largest Greek fleet, 200 in number, to repel the Persian invasion of Greece, (topped off by Greek land successes in 479).
483 B.C.	The richest *silver* seam discovered at the Laurion mines.
480 B.C.	Carthaginian struggles with the Greeks in Sicily eventually result in a Carthaginian monopoly of the *silver* and tin trade with Spain.
466–401 B.C.	Strabo says that Greek refugees settled in the Damastion *silver* mining area in what is now Yugoslavia. Damastion produced a famous *silver* coinage.
460 B.C.	The historian Herodotus travels in Italy, but does not mention Rome.
before 450 B.C.	Intermingling of Celts, who arrived via Gaul, called Celtica by Strabo, and aboriginal Iberians in S.W. France and North Spain, forming the Celtiberi (Celtiberians), their own name for themselves.
	The Celtiberians were described by Diodorus as *brilliant metalsmiths and iron-smiths* and formidable warriors. They were renowned for their *horsemanship* and were readily employed (hundreds of years later) by the Romans as *cavalry* auxiliaries.
c.450	End of the Hallstatt Period.
	the late *Iron* Age culture of the European *Celts,* called the "*La Tène*" Period, commences in Central Europe.
	Iron saws in wooden frames — like our hacksaws — used by the Celts.
450 B.C.	The *gold/silver* price ratio was usually around 1:15, but with significant local exceptions.
450–401 B.C.	More *Celtic* settlements in the British Isles.

	Population of Greece was about 3 million; (one-third were slaves). About the population of modern Toronto, Ontario.
	Influence of the metal-rich Etruscans declines in the peninsula of Italy.
414 B.C.	Thucydides travels in Italy, but does not mention Rome.
413 B.C.	The Spartans seized the *silver* mines at Laurium.
404–336	Peloponnesian War to time of Alexander.
400 B.C.	Earliest known mining of the rich Spanish mercury deposits at Almadén, which was a vital metal in the use of gold in ancient times. Gilding with the use of mercury first employed on *silver* vessels in Europe. The gold and mercury amalgam was painted on the surface of the *silver* object and when the mercury evaporated, the gold remained fused to the *silver*.
	Iron Age culture in Britain. The 4,000 mile long Great Wall of China was built in the 5th Century B.C.
400–350 B.C.	*Celtic* migrations to Ireland continue. Celtic tribes, the Norici and the Boii, invaded Bohemia (hence its name), the eastern Alps and the Hungarian plain.
400–336 B.C.	*Gold/silver* price ratio was 1:12 in Greece. Plato.
400–300 B.C.	Five *silver* phialae (bowls) modelled in the form of a lotus-blossom were made in Egypt. China probably developed the use of *cast iron* before that of wrought *iron*, in contrast to the rest of the world.
by 400 B.C.	Further *Celtic* tribes, (Galli, Gauls or Gaels) with *iron* weapons and La Tène culture, (see 450 B.C.), *invaded Italy* from the North, (displacing the *metal*-rich Etruscans), *and settled there.* In contact with Etruscan art influences.
from 400 B.C. to 191 B.C.	Northern Italy, (then called Cisalpine *Gaul*, i.e. "*Gaul* on the south side of the Alps"), remained *Celtic* for over 200 years, (i.e. until the Romans came there, 191-175 B.C.).
	Celts (Gauls) establish fortified settlements, (called "oppida" by the Romans), which eventually became the cities of Milan, Turin, Bolzano, Bologna etc. in what is now Northern Italy, which was all firmly in the hands of the Gauls by 350 B.C.
396 B.C.	The gold and *silver*-rich Etruscan city of Veii was the first wealthy victim of the early Roman Republic and in the looting, the Romans were delirious with joy at the sight of the rich *silver* and gold objects.
events of 396–390 B.C.	Rome is mentioned for the first time in history — by Theophrastus, 370-287 B.C.
390–387 B.C.	Celts from Cisalpine Gaul, (Northern Italy), (Gauls; Galli in Latin) burn and loot Rome and take a large quantity of gold said to be half a ton, as booty and retire to Northern Italy. Rome rebuilt after this Gallic invasion. City walls added by 377.
	Tin mines in Spain reported as virtually exhausted. Increased interest in British tin. See 330 B.C.
369 B.C.	*Celtic* mercenaries employed in Greece by Dionysius against the Boetians.
350 B.C.	Some Gauls leave southern France and settle among the Gauls of Northern Italy.
	Remarkable treasure of 4th Century Scythian gold, *silver* and electrum (gold-*silver* alloy), objects found at Kul Oba in the Crimea.
350–301 B.C.	*Iron* used as a working material in China.

c. 350 B.C.	King Philip II of Macedon issues Europe's first *gold coins*, (staters); also called "philips". He exploited the *gold* and *silver* mines of Mount Pangaion in Northern Greece to pay his army.
338 B.C.	The first Roman *metal coins*, (not *silver*). This crucial date in Rome's expansion marked the end of the revolt by other Latin peoples against Roman domination.
336 B.C.	King Philip II, ruler of Macedon from 356 B.C., was killed with a Celtic *iron* dagger at the age of 46.
335 B.C.	His son, Alexander III, the Great, born 356 B.C., made an accord with the Celts who lived north of the Danube, to protect his northern frontier while he invaded Persia, (334 B.C.) and pushed on to north central India. Alexander seized over 907 metric tons of *silver* and *gold* bullion and 227 tons of *gold* coins from the Royal Persian Treasure at Susa, Ecbatana and Pasargadae. The Persian treasure of *gold* and *silver* that Alexander seized was so huge that very large numbers of extra pack animals had to be found to carry it off to Macedon. (This influx of *gold* into Greece caused a fall in the value of *gold*.) Alexander also issued large quantities of gold and *silver* coins. The utility of a coinage increases with the enlargement of the area in which it is legal tender.
330 B.C.	Greek explorer Pythias of Massilia (Marseille) reaches *silver*-rich Celtic Britain. Marseille had been founded as a Greek settlement by bold Greek sailors from Phokaia whose leaders married the daughters of local Celtic chieftains in southern Gaul (France). It also in turn founded Nice (which means "Victory"). The Phocaeans were in the western Mediterranean to obtain metals such as *silver*, gold, copper, tin etc.
323 B.C.	Alexander died. His most important legacy was the creation of the Greek-speaking world of the New Testament.
by 300 B.C.	Stamped pieces of *gold*, in circulation as currency in the southern Chinese state of Ch'u, fell out of use. Romans conquer *silver*-rich area of present day Yugoslavia.
300–200 B.C.	*Gold/silver* price ratio was 1:10 at first in Greece, but during this 3rd Century, it went to 13⅓:1.
300 B.C.	Celts speaking P-Celtic (like Welsh, Cornish and Breton), possibly Belgic Celts, arrive in Ireland from Gaul via Britain. Earliest known traces of the La Tène Iron Age culture in Ireland are of this date.
300–200 B.C.	The Gauls, (Celts in what is now France), mint *gold* coins which are good copies of the design of the "philips" of Philip II of Macedon.
300–200 B.C.	Etruscans and their cities, their rich mines and lands were gradually absorbed by Rome. Etruscan gold and *silver* and mineral wealth and its people became Roman resources. Roman dominates Central Italy. The Etruscans' name survives as Tuscany, the area surrounding the Renaissance city of Florence (Firenze).
280 B.C.	Romans defeated at Arretium (Arrezzo) in what is modern North Central Italy by the Senones, a *Celtic* tribe. A Roman legion was annihilated. Roman army undertakes ruthlessly planned genocide, annihiliating the Senones home base at Rimini, women, old men and children. Senones cease to exist as a people after defeat in battle on the Tiber.
285 B.C.	Rome and the *Celts* again at war.

282 B.C.	Etruscan gold, *silver* etc. mines all taken over by Rome. (Rome issued its first *silver* coins 14 years later.)
279–278 B.C.	*Celts* (with *iron* weapons) under Brennus and Bolgios *invaded Greece* from the North, overran Macedonia (the Kingdom of Philip II and Alexander the Great) and plundered the Temple of Delphi, (centre of the Greek world), where the vast *gold* and *silver* treasures of the Greek city-states were held in sacred trust, the ultimate origin of the concept of banks. Delphi temporarily became a *Celtic* sanctuary.
277 B.C.	Both sides used *Celtic* mercenaries in the war between Pyrrhus, King of Epirus and Antigonus Gonatas the Hellene.
from 275 B.C.	*Silver* was scarce. A Roman patrician, an ex-Consul, was expelled from the Senate for owning 10 pounds weight of *silver* plates and dishes. A group of *Gallic* tribes, (Tectosages, Trocmi and Tolistoagii or Tolistobogii), who had been defeated two years before in Macedonia, settle in central Asia Minor, (now Turkey), giving their name to a new state, *Galatia,* (the *Galatians* of the New Testament). The Tectosages tribe founded Ankara (Ancyra, Angora), now the capital of Turkey.
274 B.C.	*Celtic* mercenaries serving in Egypt.
268 or 269 B.C.	First Roman *silver* coin, the denarius, is issued.
264–239 B.C.	In the First Roman war against Carthage, *Celtic* mercenaries fatally take part against Rome. Roman war against Carthage. Carthaginians lose Sicily, the Lipari islands, *gold-* and *silver-*rich Sardinia and Corsica by 239 B.C. Carthage had to pay Rome 2,200 talents (55 metric tons) of *silver.*
c. 250 B.C.	*Celtic* La Tène art style *Iron* Age people invade Britain.
250 B.C.	Maximum extent of Celtic territorial expansion in Europe and Asia, as it reaches its furthermost limits. The slow shrinking of the vast Celtic-speaking areas from Turkey to Ireland and Spain begins.
up to 240 B.C.	*Gold* and *silver* mines in the Spanish mountains, which were worked by the *Celti*berians, attracted various invaders and traders.
240–200 B.C.	The making of *iron/steel swords* by *Celti*berians was already established in Toledo, in Central Spain.
c. 240 B.C.	Greek Archimedes discovered the impurity in King Hiero's crown by weighing it in and out of water in comparison with pure gold and pure *silver.*
240–230 B.C.	Galatian *Gauls (Celts)* defeated by the Ionian Greeks (Pergamon) in Asia Minor, (Western Turkey). A marble copy of one of the greatest sculptures to survive from ancient times, "The Dying *Celt*", made just after 230 B.C., is today in Rome. The original was created in *bronze* in Pergamum to commemorate the victory and record the vanquished.
238 B.C.	Isle of Sardinia, Italy and its *mineral wealth* becomes part of Rome.
236 B.C. (or 240 B.C.)	The Semitic Carthaginians, (Carthage is near Tunis, North Africa, see 950 B.C.), conquered the *silver* mines in the Sierra Morena, North of Cordova and Seville, and north of Granada and north of Cartagena, in southern Spain, "in order to make good the loss of the (*silver*) mines in Sicily, Sardinia and Corsica" — to Rome — in the words of Hamilcar Barca, the leader of the Carthaginian force, (father of Hannibal, who accompanied him). A few years later, Hannibal drew 300 talents (about 7.5

metric tons) of *silver* a year from one mine alone. The copper deposits at Tharsis, SW Spain, were exploited at least from this date. See 1,200 B.C. Carthage later issued coinage made of electrum (an alloy of *silver* and gold).

236–222 B.C. Beginning of the systematic Roman conquest of the Po valley in Cisalpine Gaul.

225 B.C. Roman army defeats invading *Celtic Gauls* at Telamon, Central Italy. Romans then begin the slow conquest of all of Cisalpine Gaul, which means "Gaul this side (south of) the Alps", (now called North Italy.)

Spain: The Romans increasingly covet the wealth from the Spanish *gold* and *silver* mines controlled by the Carthaginians.

218 and 206 B.C. The value of *gold* relative to *silver* was fixed by the law of Rome at 1:10. This general range (with exceptions) continued to 84 B.C. when the *gold/silver* price ratio was lowered to 1:9 by Sulla.

218 B.C. Hannibal captures Sagunto, a port in Eastern Spain, starting the Second Roman war against the Carthaginians, with whom some of the *Celts* ally. Carthaginians invade Italy but could not win because of Rome's ingenious delaying tactics. during this war, the *Celt*iberian special short sword, equally suitable for thrusting and cutting, was adopted by the Roman army as a standard weapon, the one one sees in the movies.

221 B.C. *Celt*iberian troops desert from the Romans in Spain. Balearic islander soldiers served the Carthaginians well, but preferred to be paid in women, rather than *silver* or gold.

210 B.C. Petronius Arbiter made his penetrating observation, "We trained hard, but it seemed that every time we were beginning to form up (shape up as) teams, we would be reorganized. I was to learn later in life that we tend to meet any new situation by reorganizing — and a wonderful method it can be for creating the illusion of progress while producing confusion, inefficiency and demoralization". This is still painfully true today whether in mining, business generally or in the service sector.

209–206 B.C. Roman general Publius Cornelius Scipio, (Africanus Major), drives the Carthaginians out of Spain, (called Hispania in the language of the Romans), and presents himself to the *Celt*iberians as a liberator. The name of Carthage survives in Spain today in the city of Cartagena, (Carthago Nova = new Carthage), founded in 228 B.C. by Hasdrubal, son-in-law of Hamilcar Barca.

Many of the coveted *Celt*iberian *gold, silver, mercury, copper* and *iron* mines fell under Roman control.

This gave Rome the richest source of precious metals in the ancient world.

From now on, the Romans obtained most of their *silver* from Spain and supplies of many other metals such as mercury, essential in *gold* use.

207 B.C. The "denarii" *silver* coins became full legal tender in Rome.

202 B.C. Carthaginians agreed to pay Rome 300 metric tons of *silver* after defeat at Zama.

from 500 B.C. As their restless migrations ended, *urban* life develops among the *Celts* beyond Roman-controlled territory. Urban centres, i.e. permanent fortified settlements — "oppida" — spread all over *Celtic* Central and Western Europe from Bohemia to Gaul as the *Celtic* population settled land and their numbers increased. (The main *Celtic* migrations ended.) These *Celtic* oppida eventually developed into the cities of Paris, London, Vienna, Milan, Turin, Budapest, Belgrade, Ankara, etc. etc.

200–150 B.C. The ceaseless wars necessitated the payment of vast sums in *silver* coinage by Rome.

197 B.C.	First *Celt*iberian revolt in Spain in the long struggle against Rome, which was to continue for another century and a half of perpetual insurrection in this *silver*-rich country.
196–146 B.C.	Steady Roman conquest of most of Greece, with its *silver* mines.
191 B.C.	Lusitanians/*Celt*iberians fought the Roman army in *silver*-rich Spain.
191–175 B.C.	End of the long Roman struggle with the *Celts* in Northern Italy.
187–186 B.C.	*Celtic* mercenaries involved in suppressing a revolt in Upper (i.e. southern) Egypt. B. Cunliffe.
186 B.C.	*Gold/silver* price ratio was still 1:10 in Rome. Celts in Britain mint their own *silver* and gold coins.
180 B.C.	Roman *silver* denarius coin weighed 4.55 g.
179 B.C.	Roman general Gracchus puts down another revolt in *silver*-rich Spain.
169 B.C.	Roman domination of the Greek world grew with the final defeat of King Perseus.
168 B.C.	Spain had provided Rome with at least 180 tons of *silver* during the 38 years since 206 B.C. The total amount of *silver* taken from Spain will never be known.
165 B.C.	*Galatians* again severely defeated by the Pergamon Greeks in Asia Minor, (Turkey). See 275 B.C.
150 B.C.	Pliny surprised that Rome always imposed a tribute of *silver* on subjected nations, not gold, down to this period.
148–137 B.C.	Lusitanians of Iberia, (now Northwest Spain and northern Portugal, which still have a large number of Celtic placenames), under Viriathus again revolt against Rome — for 12 years. Formation after formation of Romans vanished in the western mountains. Macedonian gold mines re-opened.
146 B.C.	In the third war with Rome, Carthage (Tunis, North Africa) was destroyed completely by the Romans under General P. Cornelius Scipio Aemilianus, (Africanus Minor), adopted grandson of Scipio Africanus Major. Of 500,000 inhabitants, only 50,000 survived and they were sold into slavery. Only two tons of *silver* were found in the city. No *gold* is mentioned. The *silver* would have been of Spanish origin, presumably. All gold and *silver* was reserved for the Roman state. All other things were plunder for the troops. Scipio Aemilianus, the general, owned about 32 pounds of *silver.* *Rome sacks Corinth; Greece under Roman domination.*
143–138 B.C.	*Silver* shekel and half-shekel coins minted in Palestine inscribed "shekel of Israel", attributed to Simon Maccabaeus, who ruled officially 141-137 B.C.
134–133 B.C.	*Celt*iberian fortress of Numantia, N.E. Spain, conquered by Roman General P. Scipio Aemilianus, (Africanus Minor).
133 B.C.	Attalus bequeaths Pergamum to Rome, bringing Romans to the frontier of Galatia.
125–75 B.C.	Further Belgic (*Celtic*) tribes migrate to S.E. Britain from the Continent, to escape harassment by the Germanic tribes advancing from the north and the east. The *Celtic* Belgae had better *iron* tools and heavy horses to pull *iron*-bladed four wheeled ploughs that could exploit heavier soils. Belgic Celts left *silver* brooches in their graves in Kent.

121 B.C.	Romans conquer southeastern Gaul (modern Provence).
113 B.C.	Panic in Rome. "Second Celtic Storm". Battle of Arausio. *Celt*iberians again war against Rome in Spain.
106 B.C.	The vast treasure hoard of *silver* and gold of the *Celtic* Volcae Tectosages tribe in Southern Gaul pillaged by the Romans.
by 100 B.C.	Germanic tribes reach Southern Germany. Their ancient word for *silver* was "silabar", which eventually was to give us our word *silver* in English.
c.100 B.C.	A magnificent large *silver* cauldron or bowl of *Celtic* manufacture, of the first or second century, with remarkable repoussé decoration, called the Gundestrup bowl, is the greatest surviving masterpiece of *Celtic* art. It is over 27 inches across, 16.5 inches high and weighs about 20 pounds, of solid silver.
before 100 B.C.	Rome could decline war indemnities in gold and insist on *silver.*
c. 100 B.C.	*Celtic* tribes (Ancient Britons) such as the Dobunni of the Cirencester area of the South West of England and the Iceni of East Britain, where Boadicea (Boudicca) was Queen much later, minted *silver* and *gold* coins of the Gaulish type.
from 100 B.C.	More incursions of German-speaking groups into *Celtic* areas in what is now Southern Germany and Eastern France.
	The famous Olbia Treasure hoard of this date found in recent years near Olbia, north of the Crimea, Russia, which, although mostly of gold, included a *silver* distaff now in Hartford, Connecticut. Olbia is a *Celtic* archaeological site. (Cunliffe)
100 B.C.–1 A.D.	Beautiful *silver* cup found at Welwyn, Hertfordshire, England is of this date.
84 B.C.	*Silver/Gold* Price Ratio lowered in Rome by Sulla to 9:1 from 10:1. *Silver* more valuable than before.
	Germanic trading princes, offering much better *iron* than the *Celts,* traded with Roman provinces for wine and luxuries.
81–77–71 B.C.	Another Lusitanian, (Portugal and Galicia, NW Spain), revolt in Spain (under Quintus Sertorius) was put down by Roman general Pompey the Great.
75 B.C.	A further major invasion of southeastern Britain by the Celtic Belgae.
61–60 B.C.	Julius Caesar, burdened by great personal debts, conquered Celtic Brigantium (the port of La Coruna) in *gold*-rich *Galicia,* (the *Gallaeci* and Brigantes tribes), Northwest Spain, the last refuge of the *Celtiberians.* All of the Spain's *mineral wealth,* in *silver,* gold etc., now came under Roman control. Caesar returned rich and paid off his debts.
58–49 B.C.	Julius Caesar's nine year war in *Celtic* Gaul completes the subjugation of most Celts on the Continent. Many *Celtic silver* and *gold* mining operations were seized by Rome.
	Gold/silver price ratio was 1:8.9 in Rome. *Gold's* value fell because of the influx of Caesar's looted *gold* from Gaul.
55 B.C.	Julius Caesar's armed reconnaissance landing in southeast Britain.
54 B.C.	Cassivellaunus, a powerful Belgic (*Celtic*) tribal leader in southern Britain, agrees to pay tribute to Rome.

50 B.C.	Effective end of the *Celtic* La Tène *Iron* Age Culture era on the Continent of Europe, as the Romans take charge, after the war in Gaul. However, La Tène *Iron Age art in silver, gold,* etc. continued for another four hundred years in Ireland. In other words, it lasted longer in Ireland than anywhere else, i.e. 400 years on the continent from 450 B.C. and 650 years in Ireland, from 300 B.C. One of the most remarkable treasure hoards of *silver* known from ancient times is the Hildesheim hoard from Hanover, Germany. It includes eight plates and trays, eight bowls, nine cups, six dishes, two urns, a bucket, two tripods and a candelabrum, all of *silver. One piece at least is unsurpassed among surviving examples of Greek/Roman silversmithing,* a two-handled dish. See late 1st Century B.C.
47 B.C.	All *Galatia* and Asia Minor around it is now Roman.
46 B.C.	Julius Caesar's triumphant return to Rome was a testament to the political power of gold and *silver* (loot).
19 B.C.	The final breaking of the 148-year *Celtic* resistance in Spain was not achieved until Augustus, 19 B.C., who needed three legions to garrison North West Spain, (*gold*-rich Galicia of the *Celtic* Gallaeci tribe).
15 B.C.	The *Celtic* town of Noricum (Noreia, Nyrax) — near Klagenfurt, SE Austria — famous for its Noric *iron* and *steel,* was seized by the Romans. The famous Noric *steel* was then used for Roman army weapons. (Noricum is some 70 air miles from Hallstatt, which is 31 miles SE of Salzburg.)
8 to 4 B.C. est.	Jesus born.
9 A.D.	Payment of exceedingly scarce gold and *silver* as taxes to the Romans causes North German tribes to revolt and destroy three Roman legions. The result was that North Germany was never Romanized. IF IT HAD BEEN, THERE NEVER WOULD HAVE BEEN AN ANGLO-SAXON ENGLAND AND SO NO ENGLISH LANGUAGE.
1 to 37	*Silver/Gold* Price Ratio 10:9 in Rome. Reigns of Augustus and Tiberius.
5-40 A.D.	Cymbeline, (see Shakespeare), who was really Cunebolinus, King of the Catuvellauni, a *Celtic* tribal group, was recognized by Rome as Rex Brittonum (King of the *Celtic* Britons).
16 A.D.	The first known definite reference to diamonds.
30 A.D.	Spanish mines under Rome were producing about 10 metric tons of gold a year.
30 or 34 A.D.	Jesus executed in Jerusalem. He was betrayed by Judas for a price of 30 pieces of *silver,* probably not denarii of Rome but Greek tetradrachms of Antioch etc., (each worth 3 denarii). 30 *silver* tetradrachms was then the accepted settlement price for a slave, if killed by an animal. (About 1,600 B.C., the young Joseph was sold by his brothers for 20 pieces of *silver.*)
35 A.D.	The Romans begin to perceive from the reports of travelling merchants that Britain is *rich in minerals.* Because of the island's mineral wealth, it was described in Latin as "opulentissima insula", (a most wealthy island).
43 A.D.	Accordingly, Roma imperator Claudius captures the most important *Celtic* British settlement, Camulodunum (Camelot or Colchester, Essex) and begins the slow Roman conquest of *Celtic* Southern Britain. (n.b. The Romans *never* conquered *Ireland* or the Highlands of Scotland.) Cogidubnus, a *Celtic* British chief, welcomes them and the Romans built him a palace of great splendour at Chichester.

50 A.D.	The Romans learn the use of soap from the Gauls (*Celts*). Rome exploits Britain's metal resources, *silver, lead, copper, tin, iron, gold* etc. Caradoc (Caratacus), son of the great *Celtic* war leader, Cunobelin (Cymbeline) of Colchester, British *Celtic* rebel leader against Rome, is captured after defeat in battle at Clun, Salop.
c.50 A.D.	Hoard of precious metal Celtic torcs (neck-rings) at Snettisham, Norfolk, England contained a heavy electrum (natural gold and *silver* alloy) Celtic torc about 20 cm. in diameter.
54–68 A.D.	*Silver/Gold* Price Ratio 11.8:1 in Rome. Reign of Nero. Pliny complained that India's spices, especially pepper, jewels, muslins and exotic animals were costing Rome about 550 million sesterces (about 588 tons a year in gold — paid partly in *silver*). Rome also bought precious stones, diamonds, turquoise, spikenard, indigo, silk yarn and tortoise shell.
59 A.D.	Date of large ingot or pig, weighing about 180 pounds, stamped "British lead from the *silver* mines of Graius Nipius Ascanius", i.e. cast from the residue of the *desilverisation* process. Britain "yields gold and *silver* as the prize of victory". — Tacitus.
61 A.D.	Boudicca (Boadicea) British Queen of the *Celtic* Iceni tribe of Eastern Britain leads major revolt against the Romans — is defeated and commits suicide. Boudicca means "Victoria".
63 A.D.	Emperor Nero reduced the *silver* content of the denarius coin, alloying it with 10 per cent copper.
79 A.D.	The sumptuous Boscoreale Treasure Hoard, comprising one hundred and three *silver* vases, was buried by the same volcanic catastrophe that destroyed Herculaneum and Pompeii. It is now in the Louvre, Paris, having been excavated in 1893-94.
80 A.D.	Roman general Agricola invaded what is now Scotland.
81–96 A.D.	*Silver/Gold* Price Ratio 11.3:1 in Rome.
83–84 A.D.	Roman general Agricola crushes the last Celtic army in Britain, that of the Caledonians (Picts), in a battle at Mons Graupius (Scotland) but does *not* obtain the Highlands. "Scots" (Scoti) is the Latin name for the Irish. "Pict" is debased Latin for "painted", applied by Romans to the Kal'd (Caledonian) tribes north of the Forth, who were never subdued by the Romans; nor were the Irish. The Picts were substantially *Celtic* in origin (Cunliffe) and their known leaders had *Celtic* names.
late 1st Century A.D.	Alternative date for Hildesheim treasure hoard of *silverwork;* comprised 70 pieces — one of the finest collections of *silver* from the Roman world. Found in 1868. See 50 B.C.
97–106 A.D.	Romans remove an estimated 25 tons of *gold* from Dacia (Romania).
117–118 A.D.	At the height of the Roman Empire and its greatest geographical extent, every single gold and *silver* mine then known was under its control. Deterioration of the *silver* currency after Trajan. Hadrian becomes Emperor. The Roman 9th Legion is annihilated and disappears from history, (a rare event), in fighting an obscure rising of the tribes in Northern Britain. Roman Empire takes on a defensive posture.
122–127 A.D.	Emperor Hadrian visits Britain. The formidable "Hadrian's Wall" erected east-west from the Tyne river to the Solway estuary, 73 miles long, by Aulus Platorius Nepos, to keep out the Pictish tribesmen (Caledonians) of northern Britain.

127 A.D.	*Silver*/gold ratio about 1:12.5 to 13.
139–142 A.D.	The ill-fated Wall of Antoninus Pius, Forth to Clyde, in the Lowlands of Scotland, 37 miles long, is erected by Roman Quintus Lollius Urbicus, well to the north of Hadrian's Wall.
180 A.D.	Beginning of the "Decline of the Roman Empire".
186 A.D.	Romans defeated in Lowland Scotland. Antonine Wall abandoned by the Romans as a failure after only 44 years. Retreat of the Romans permanently to "Hadrian's Wall" further south in Britain.
196 A.D.	Roman governor Clodius Albinus withdraws forces from Britain in attempting to become Emperor. Northern Britain overrun by Picts and Celts.
200 A.D.	A *Celtic* tribe, the Scordistae, or Scordisci, living in the Middle Danube region, now mainly in Yugloslavia, valued *silver* above *gold*, according to Athanaeus. They founded the city of Singi-dunum, now Belgrade, capital of Yugoslavia.
208–209 A.D.	Emperor Septimius Severus visits Britain to punish the Caledonians (Picts) and *Celts* for the 196 A.D. incursions. Died at York 211 A.D.
214 A.D.	Germanic tribes reach the Black Sea.
240 A.D.	The Franks, a German-speaking tribe, (who were to give their name to France), first appeared in Europe.
259 A.D.	Break-away "Gallic Empire" set up; suppressed by Rome in 273, (14 years later)).
287 A.D.	Britain independent temporarily under Carausius, a *Celtic* admiral.
296 A.D.	Constantius Chlorus, one of two co-equal Caesars of Rome, came to Britain to campaign against the Picts and regained Britain.
	Germanic-speaking pirates from Saxony (North Germany) raid Britain regularly from now on.
306 A.D.	Constantine (the Great) proclaimed Emperor in York, on the death of his father Constantius there.
312 A.D.	*Gold/silver* price ratio was 1:14.4 in Byzantium, (Constantinople), the new capital of the Roman Empire under Constantine, son of Constantius.
313 A.D.	Christianity officially tolerated in the Roman Empire, including Britain, by an edict of the new Emperor Constantine the Great, illegitimate son of the Caesar Constantius and Helena (see 296 A.D.). This enabled him to seize the treasures of precious metals held immemorially in trust in or owned by the numberless pagan temples and this put vast stocks of *silver* and gold bullion in his hands.
	The remarkable and superb hoard of Roman *silverware*, the Mildenhall Treasure, including the finely chased and engraved *silver* Great Dish and the *silver* platter, bowl, goblet and spoon, buried in this century, found intact in Suffolk in 1942. The purity was 95-97 per cent *silver*.
326 A.D.	No mint for coinage in Roman Britain after this date. See 625-649 B.C.
342–343 A.D.	The Emperor Constans came to Britain to deal with a crisis, the last reigning Emperor to visit Britain.
350-450 A.D.	The famous gold and *silver* treasure hoard of this date was found at Pietroasa, north of the lower Danube. It was owned by a Germanic Goth. It includes a famous gold collar, neck ring or torque which weighed 25 ounces and was six inches in diameter-

	one of several massive gold collars or torques. The Pictroasa treasure was transported to Moscow in World War I and has never been returned.
350 A.D.	Earliest surviving writings in the *Irish Celtic* language in Ireland. Effective end of the La Tène *Iron* Age culture in Ireland. *Celtic* Irish raids on Roman-occupied Britain. The key military Roman Legion towns of Chester and Caerleon, both near the sea, destroyed.
the years after 350 A.D.	At Kaiseraugst, 6 miles east of Basel, Switzerland, a remarkable Roman *silver* treasure of this time was discovered during the winter of 1961/62. For the variety and importance of objects it contains, it may be compared with the famous treasures of Boscoreale, Hildesheim and Mildenhall. It includes a large number of spoons and other table utensils, a richly decorated candelabrum, unusually large *silver* dishes, such as the famous Achilles plate depicting scenes from the life of the hero and a plate *nielloed*, (see Glossary Appendix), with a view of a harbour; also a *silver* statuette of Venus, three *silver* ingots and 186 coins of Constantine the Great and his sons (330-349 AD) in a perfect state of conservation. The treasure may thus be dated back to the years after 350 AD, probably buried in the time of the sons of Constantine.
354–359 A.D.	The *silver* hoard found at Oldcroft, Gloucestershire, England contained a Celtic *silver* pin and 3,330 Roman coins. Another such pin was found at Atworth, Somerset.
360 to 367 A.D.	Combined assaults by Picts and "Scots", (i.e. the Irish of southwest Scotland) and Germanic Angles, Saxons and Franks on the Romanized area of Britain were organized successfully.
367 A.D. (or 388)	On behalf of Rome, Maxen Gwledig (Magnus Maximus in Latin) repulses them, to the relief of the British Celts, but henceforth there is a rapid decline of towns and the villa economy. Revival of the Celtic pagan religion.
369–370 A.D.	Roman rule temporarily restored in Britain by Theodosius, a general.
370 A.D.	At about this time, Britain exhibits a wealth of *silver* unexampled in any other western Roman province. There was an abundance of late-Roman *silver* in the Somersetshire area. *Silver* was the principal money of account. The treasure hoard of *silver* found at Traprain Law had a purity of 94.08, 96.2 and 95.3 per cent *silver*. The Mildenhall treasure averaged 95-97 per cent *silver*.
372 A.D.	Huns from Asia enter Europe, driving more and more Germans into the Western Roman Empire.
373–387 A.D.	Roman legions under self-proclaimed Emperor Magnus Maximus begin with the process of evacuating Britain. He conquers Gaul and Spain.
388 A.D.	Theodosius of Rome defeats and kills Magnus Maximus but Britain's link with the Roman Empire remained weakened. Maximus' impact on Britain was thus permanent and ultimately beneficial to the freedom of the *Celtic* Britons, but, at the same time, it made it easier for the Germanic Angle and Saxon tribes to invade and eventually conquer that part of Britain which is now called England.
	What is now Scotland was peopled by three *Celtic* language peoples, the Irish settlers (Scots) in the southwest, the Picts who ruled north of the Firth of Forth, the *Celtic* Britons in Strathclyde (the Clyde Valley) and the Germanic language Angles of the southeast.
391 A.D.	Christianity officially becomes the Roman Empire's state religion. German troops and commanders now dominate the Roman Armies.
late 300's A.D.	The Traprain Law, (East Lothian, Scotland), Treasure hoard, all of *silverwork*, contained a number of undamaged pieces such as a *silver* chalice, spoon, vase and

	bowl. Traprain was a large hill-fort settlement of the Celtic Votadini tribe of *SE Scotland. The settlement had about 3,000 people.*
late 300's A.D.	The spectacular *silver* treasure found relatively recently at Chesterton-Water Newton (Durobrivae) in Cambridgeshire, England contains nine undamaged *silver* vessels — jugs, bowls, a cup, a *silver* strainer 8 inches long and a *silver* bowl, diameter 6.5 inches. Purity was 95-97 per cent *silver.*
400–410 A.D. period	Stilicho, of the Germanic Vandal tribe, who was the Roman Supreme Chief of Staff, stabilises Britain, but removes many Roman troops from Britain in 402 to defend Italy against the Germanic Visigoth invasion. As the Roman armies left Britain forever, effective Roman rule ended after about 360 years.
	Germanic Goths under Alaric the Goth take Rome itself and sack the city, 408 A.D. He received as ransom 13.5 metric tons of *silver*, 2.25 tons of *gold and* 1.5 tons of coveted pepper.
	Emperor Honorius tells the Britons to arrange for their own defence.
	Britain is independent again, nominally autonomous within the Empire. The *Celtic* language reemerges in Britain and the Latin of the Romans largely disappears. There are some remnants of imperial Latin in the surviving Welsh (Celtic) language, which is still spoken today.
	Metal mining virtually ceases. Anarchy of a kind ensues for the *Celtic* Britons who break up into independent territorial units.
	Devastating new raids on a now militarily weak Britain by pagan *Picts* and *"Scots"*, (*i.e. the Irish* of southwest Scotland and Irish from Ireland itself).
406 A.D.	The Roman frontier on the Rhine collapses. Hordes of Germanic tribes cross the Rhine and enter Roman Gaul (France).
	Germanic tribes, (Vandals, Suevi and Alans) burst into Gaul and Spain; later more Visigoths (West Goths) too. Their names survive in Spain in areas like Andalusia (Vandal-usia) and Catalonia (Goth-alonia).
410 A.D.	Great Germanic Saxon attack on Britain.
419 A.D.	Germanic Visigothic kingdom commences in *silver*-rich Spain and much of France, Toulouse being their centre at first. It lasted in Spain to 700 A.D.
423 A.D.	Date of *silver* hoard found at Coleraine, NE Ireland. It contained seven stamped *silver* ingots and 1,506 Roman coins. The hoard found further south of Balline in Ulster NE Ireland had four *silver* ingots and three pieces of chopped up silver plate.
425 A.D.	No Roman imperial forces or administration in Britain.
425–459 A.D.	First large scale invasions of Britain by the pagan Jutes, Angles and Saxons from the continent, speaking Germanic languages, (*thus providing the basis of our modern English language*).
	Although the Anglo-Saxons were mostly Saxons, not AEngli (Angli), they called themselves *AEnglisc (English)* because members of the Anglian royal family were the highest in rank of those leading the settlers in Britain. Such was the royal rank conscious Germanic custom.
c. 425 onwards.	The Germanic Salian Franks rule in northern Gaul under Chlogio or Clodio.
429–430 A.D.	The *Celtic* Britons, in desperation, fatally employ some Germanic mercenaries (in the old Roman tradition) against the *Picts* in the North.

	Pagan Caledonian "Picts" from Eastern Scotland and "Scots", (Irish Gaelic speaking settlers in SW Scotland), are expelled from southern England by Germanic Saxon, Jute and Angle mercenaries.
430 A.D.	*Silver* and copper coins cease to circulate meaningfully in Britain after this year. Emperor Theodosius II forced to pay the Huns 350 pounds weight of gold a year.
431 A.D.	The Pope sent Palladius to those of the Irish who believed in Christ.
432–461 A.D. (or 457–492 A.D.)	Christianization and Europeanization of *Celtic Ireland* continued by Patrick, born about 389, a Romanized *Celtic* native seized as a young slave in an Irish raid on Britain. He followed Palladius, the first Rome-appointed bishop in Ireland.
438 A.D.	*Gold/silver* price ratio is still 1:14.4, (Theodosian code.) See 312 A.D.
441 A.D.	*The pagan Anglo-Saxon conquest of Southeast Britain slowly began.* Germanic mercenaries employed by the *Celtic* rulers mutinied. Romanized British civilization was destroyed, town by town. (These early Angles and Saxons did not use towns and the retreating *Celtic* Britons had no particular love for these Roman style settlements either, apparently).
444 A.D.	In Britain, bubonic plague epidemic killed thousands.
446–454 A.D. (traditional)	"Groans of the *Celtic* Britons" — their last appeal (in vain) to Aëtius, Roman commander-in-chief, for help against the Angles and Saxons.
450 A.D.	Britain now clearly an independent country ruled by Celtic princes, but Angles, Saxons and Jutes begin their slow conquest of Britain.
	Gold and *silver* coins cease to circulate in Britain.
451 A.D.	Attila and the Huns, (mixed Turkic and Mongol armies), raided Gaul (France) and were permanently defeated by combined Germanic peoples, (Franks, Visigoths, Saxons and Alemanni) and some Romans, all under Aetius at Mauriac, (the Catalaunian Fields) near Troyes, ESE of Paris. The Hun threat to Europe (raid into Italy in 452) finally ended when Attila died in 453. Troy ounces, still used to weigh gold, *silver* and other precious metals as they have for centuries, take their name from Troyes, a prominent mediaeval market town.
455 A.D.	Germanic Vandals sack Rome.
	The *Celtic* Britons, led by Vortigern, defeated by invading Jutes at Aylesford, Kent.
	Angles, Saxons and Jutes from Denmark and NW Germany settle in SE Britain and seize more and more territory.
456 A.D.	Death of Merovech, founder of the Germanic Frankish dynasty in Gaul — son of Chlogio.
459 A.D.	British *Celtic* political leaders are assassinated. Some of the surviving nobility and their followers emigrated to Brittany and Gaul, (hence the name Brittany and that of the people there, the Bretons, down to this day). Collapse of the *Celtic* British economy.
461 A.D.	Valimir and the Ostrogoths rebelled against the Eastern Roman Emperor and were bought off with 300 pounds weight of gold.
466–484 A.D.	Visigothic power in Spain reaches its peak under Euric.
475 A.D.?	*Arthur* born in Britain. He eventually became leader, ("dux" or duke), but not king, of the *Celtic Britons*, against the new Anglo-Saxon settlers in South East Britain, over several decades.

476 A.D.	The Fall of Western Rome. The last Roman pretender to the position of Emperor of the Western Roman Empire, Romulus Augustulus, deposed by Odoacer (Odovacer) of the Alanic Sciri people, the leader of the barbarian Goths etc. of the Imperial Guard, who took control. His *silver* coins were struck all over Italy.
477 A.D.	The Saxon Aelle lands in Sussex (South Saxon Land).
486 A.D.	In Gaul, Glovis (Chlodwig), (modern Ludwig), five years after the death of his father Childeric I, principal King of the Germanic Salian Franks, who was the son of Merovech, ancestor of the Merovingian Frankish dynasty, was victorious near Soissons against the nominally Roman-Gallic (but mainly German) forces under Syagrius, the last commander of a Western Roman army and last Roman governor of *Celtic* Gaul. Monetary problems had begun to develop under Childeric, as *gold* became very scarce. The *Gallic* (French) coastline facing Britain was now controlled by Germanic Franks, except in *Celtic Brittany*. Clovis, a Christian, ruled 481-511 A.D. This was the end of Roman rule in *Gaul*, after 537 years, (whose name now becomes Francia or Frankland, i.e. France). Unlike the Latin disappearance effect in Britain around 410 A.D., a Celtic form of the Latin language survived in France, in spite of the Germanic speech of their new conquerors. We still talk of the Gallic (i.e. Celtic) temperament of the French. There are over 7 million people of French descent in Canada. One must remember that the Frankish rulers and their retainers and Franks-only army were small in numbers and the population remained Gallo-Roman, i.e. latinized Celts. The Germanic Franks were gradually absorbed by that population.
493 A.D.	Theodoric the Great, the Ostrogoth (East Goth), the greatest Germanic leader of his day, ambushed Odoacer, ruler of Italy and leader of the first Alanic and Gothic settlers in Italy. Theodoric, leader of the Ostrogoths who invaded Italy, was the first independent Germanic King in Italy, ruling until 526. His *silver* coins were subspecies used for regular exchange. A count with the Latin title of "comes sacrarum largitionum" was responsible for *mines* and mints (gold and *silver*) and other matters. He had to be highly capable and extremely trustworthy. Workers in metal were known as "aiya-smitha" in Gothic.
495 A.D.	Cerdic and Cynric land in SW Britain, as leaders of Germanic Saxons.
500 A.D. (or 515 A.D.)	Germanic Anglo-Saxon invaders advance in Britain, but are halted by the *Celtic* Britons by their victory in a two-day battle at Mount Badon, (Wiltshire). Arthur appears among the *Celtic* British leaders. It checked the Anglo-Saxon advance into SW England for nearly 50 years.
early 500's	By the 6th Century, Ireland was definitely the centre of gravity of Christianity and civilization and metal-working in the West of Europe.
500–800 A.D.	Golden Age of Irish monastic scholarship.
500–700 A.D.	Supply of newly mined gold in Western Europe fell away almost to vanishing point. Christianized Gaelic-speaking Irish Scoti (Scots) steadily settle in what is now Southwest Scotland, from the year 501, with the pagan Picts and the P-*Celtic* (Welsh) speaking Britons in Strathclyde as their neighbours.
506–507 A.D.	Clovis the Frank effectively confines the Visigoths to Spain, by his victory at Vouille near Poitiers, France.

511–558 A.D.	Frankish King Childebert I of Paris also had power in Britain.
514 A.D.	West Saxons land in Southern Britain.
518 A.D.	At his death, the Emperor Anastasius left 140 tons of *gold*.
525 A.D.	Date of the treasure hoard, including *silver*-gilt hilted sword and *silver*-studded shield, spear and knife found at Finglesham, (Prince's Manor), Kent.
from 527 A.D.	The gold/*silver* price ratio was 15:1. Eastern Emperor Justinian tries to re-establish Byzantine rule over Italy. This takes until 554.
537 A.D.	Rule or leadership of the famous Celtic "King" Arthur ends in Britain, reputedly killed at the Battle of Camlan after many decades leading the Britons in fighting the pagan Angle and Saxon invaders. The Christian Celtic Britons, whose language was like modern Welsh, slowly retreat into Brittany, Cornwall, Wales and Scotland, (some to Ireland).
540 A.D.	Women's brooches of gilded and *nielloed* (see Glossary) *silver* of this date found in Kent. The Empress Theodora in Constantinople (Byzantium) introduces *gold* embroidery and tiaras. On relinquishing power, she surrendered 55 tons of *gold*. During her regency, the Byzantine treasury included 3,000 centenaries of *silver*. The gold/*silver* ratio was 14:1.
540–600 A.D.	Date of the oldest surviving Welsh, (i.e. the British form of *Celtic*), poetry by Taliesin, Aneirin, Myrddin and Llywarch Hen.
546 A.D.	Totila, the Germanic Ostrogoth King, captures Rome. His nobles wore armour of gold and *silver*.
547 A.D.	Yellow Plague in Britain.
550–600 A.D.	Second Anglo-Saxon revolt against the Celtic Britons permanently mastered most of Britain, which is, (from then on), to be called England, (AEngles- or Angles-land).
554 A.D.	Byzantine rule over Italy re-established and Ostrogothic rule there extinguished. The East Roman Emperor in Constantinople (Byzantium), Justinian, accepted the exchange ratio of gold and *silver* in Italy established by Theodoric the Great.
558 A.D.	Bubonic plague and smallpox killed millions in Europe. Avars enter Eastern Europe and drive Slavs and the Germanic Lombards west.
536 A.D.	Columba, Irish abbot and missionary, (of Irish royal descent), basing himself on the Isle of Iona, begins to convert the Picts of Scotland to Christianity, i.e. hundreds of years before most of the Anglo-Saxons of southern England were successfully converted. He died in 597.
566 A.D.	Irish poet Colman mac Lenine refers to (*silver*) "pennies to a pound".
c.567 A.D.	Avars probably the greatest power in Europe.
570 A.D.	Birth of Muhammad, founder of Islam.
575–775 A.D.	Many small, rather crude *silver* coins known as "sceats" or "sceattas", were issued in England during this time, the Early Anglo-Saxon Period. Some have a small bird on the obverse which has been identified as a starling. This is perhaps the origin of the world "sterling".
577 A.D.	Saxons conquer Bath, Gloucester and Cirencester in Wessex, Southwest England, (an important part of Arthur's old *Celtic* base area). The English of Wessex (West Saxons) defeat the *Celtic* Welsh at Deorham.

c.580 A.D.	The superb and incredibly intricate heavy *silver* Ardagh chalice, with fine decoration in gold, gilt-bronze, glass and enamel, created in Ireland. It can be seen today in Dublin.
585 A.D.	The vast hoard of *silver* and gold at Avignon seized from Mummolus, Count of Auxerre, by King Guntram (Gontran) the Frank in Gaul (France), died 593, is reported as comprising 250 talents (over 13 tons) of *silver* and more than 30 talents of gold (over one and a half tons). One *silver* plate alone weighed 80 kilograms or about 170 pounds.
	At about that time, there was a terrible famine in Gaul. Many died. The merchants took advantage of the people, selling a bushel of corn (wheat) or a half measure of wine for a third of a gold piece. The poor sold themselves into slavery in order to obtain something to eat. A third of a gold piece, i.e. a bezant or solid gold coin, would be about 1.4256 grams of gold, worth about U.S.$16.00 today, (for a bushel of wheat which costs only about $4 today). A third of a gold piece would have been equivalent to about 5 *silver* coins.
	The Frankish King Childebert II of Gaul, died 595, received 50,000 pieces of gold (bezant coins), about 3.5 metric tons of gold, from the Emperor Maurice in Byzantium (Constantinople) to rid Italy of the Germanic Langobards or Lombards, who give their name to Lombardy there.
597 A.D.	(St.) Augustine from Rome lands in the Anglo-Saxon kingdom of Kent, SE England, where there was a christian Queen Bertha, (Adelberg or Ethelburg), a Frankish princess, daughter of Charibert, Frankish King of Gaul, (died 567 A.D.), grandson of the first Germanic Frank ruler of Gaul, Clovis (Chlodwig, Chlodovech, Ludwig). Charibert's first wife Ingobert, Bertha's mother, was devout and Bertha was raised as a Christian and remained so when she married Ethelbert (Aethelbert), the pagan King of Kent, who eventually became the first Christian Anglo-Saxon King, dying in 616.
	The Anglo-Saxon kings of Kent, Mercia, Wessex, etc. and the Frankish (French) and German Kings in Europe were to become very important in the history of *silver*.
late 500's A.D.	Norrie's Law, Fife, Scotland; the undamaged *silver* hoard contains a *silver* repoussée plate with trumpet pattern spirals like those of Monasterevin, Ireland. It also contained huge plain *silver* brooches. These are Pictish.
	The Gaulcross, Banff, Scotland *silver* hoard is Pictish and contains massive *silver* chains weighing up to 2.6 kg. each.
600 onwards	Development of the *goldsmith's* art as *jewellery* in Frankish Gaul. See Charlemagne, 768-814 A.D.
early 600's	Regular *silver* coinage definitely known to be issued in Anglo-Saxon England. The earliest are those of King Eorpwald of East Anglia, about 616-628 A.D. Augustine's early successes with conversions in nearby Essex were not maintained and Essex reverted to paganism.
between 616 and 627 A.D.	Redwald, the fourth Bretwalda or Brytenwalda (mixed Celtic and Anglo-Saxon title for "Ruler of Britain") died. The remarkable treasure hoard found at Sutton Hoo, Suffolk, East Anglia, is believed to be his ship burial mound, dated by some scholars at 625 A.D. Beautiful *gold* and *silverware* items predominate, particularly a great *silver* dish, two *silver* spoons and 10 *silver* bowls. The *silver* dish was made between 491 and 518. The *silver* bowls were probably Celtic in origin.

	The huge "Anastasius" *silver* dish from Sutton Hoo, diameter 72.4 cm., has two control stamps of the Emperor. The hoard also contained seven *silver*-decorated drinking vessels.
618 A.D.	King Eorpwald of East Anglia issues the first known English (Anglo-Saxon) *silver* coins.
621 A.D.	Swinthila the first Visigothic King of all *silver*-rich Spain.
622 A.D.	The Muslim Era dates from this year — that of the Hegira (Flight) of Muhammad to Medina.
625 A.D.	Anglo-Saxon Queen Ethelberga of Northumbria, sister of the King of Kent, wife of converted pagan King Edwin, (Aeduin, killed 633), received a *silver* mirror from Pope Boniface IV. The Gourdon *gold* chalice made in Frankish Gaul.
625–649 A.D.	Penda, King of Anglo-Saxon Mercia, West Central England, in this period, is believed by some to have given his name to the *silver* penny or piece of the Anglo-Saxons. See 765 A.D.
629 A.D.	St. Eloi, a *goldsmith* and patron saint of craftsmen, was Treasurer to Dagobert, King of the Franks. A set of Byzantine *silver* plates depicting the life of King David, made between 610 and 629, found near Kyrenia, Cyprus in 1902.
632 A.D.	Death of Muhammad. Abu Bekr, father of one of his wives, succeeds him as the first Caliph (Khalifa or "successor"). The followers of Islam would greatly change the trade patterns of *silver* and *gold*, particularly in Western Europe.
632–633 A.D.	End of any effective British *Celtic* challenge to the Anglo-Saxons in what is now England proper. From this date, however, *Celtic* missionaries are active in most of the largely pagan Anglo-Saxon territory in Britain.
634 A.D.	Oswald, Anglo-Saxon King of Northumbria, Northern England, brings in *Celtic* Christianity from the Irish. See 625 A.D. This was the second area of England to be Christianized.
635 A.D.	Wessex converted to Christianity.
from 650 A.D.	The money actually in use from at least this date was entirely *silver*, according to the Anglo-Saxon laws which survive.
653 A.D.	Essex converted to Christianity.
655 A.D.	Anglo-Saxon Northumbria reduces to vassalage the Picts, the Scots and the Strathclyde Britons of southern Scotland. On the death of the last great pagan Anglo-Saxon King, Penda, Mercia converted to Christianity.
656 A.D.	Ali, husband of Muhammad's daughter Fatima, becomes fourth Caliph of Baghdad. Assassinated 661.
663–697 A.D.	"Roman Christianity's triumph over *Celtic* Christianity in England at Synod of Whitby as Anglo-Saxon Northumbria opts for Rome.
675–704 A.D.	The earliest Anglo-Saxon *silver* coins which can be identified with certainty are marked with the name of Aethelred, King of Mercia, West Central England who ruled during these years, a contemporary of Kings Centwine, Caedwalla and Ine of Wessex and Egfrith and Aldfrith of Northumbria. Queen Elizabeth II descends from Ine's father, King Cenred.
684 A.D.	Egfrith, King of Northumbria, sent an unsuccessful Anglo-Saxon military expedition to gold- and *silver*-rich Ireland.

691–725 A.D.	Hoards of *silver* coins — sceattas of Wihtred, King of Kent — have been discovered.
695 A.D.	The Picts and Scots throw off the Northumbrian control of southern Scotland. See 655 A.D.
700–800 A.D.	New *silver* mines discovered in South China. This led to a form of currency for large transactions, replacing bales of silk cloth. *Silver* was not minted as coins, which resulted in control of the "currency" passing into the hands of *silversmiths* in China.
	As *gold* became scarcer in Europe there was a switch to *silver*. (The scarcity of *gold* in Western Europe lasted another 500 years.) Stable *silver* currency had been established in England by the Germanic Anglo-Saxons before this period.
	Frankish coinage in Gaul declines from gold into *silver*.
c.700 A.D.	The superb undamaged Hunterstone Celtic brooch from Ayrshire, Strathclyde, Scotland is of solid *silver*, decorated in gold, *silver* and amber.
700 A.D.	Approximate end of the 300-year rule of Germanic Visigoth kings in Spain (with Roderic). See 406 and 419 A.D.
	Mines producing metals reactivated in Britain.
711–713 A.D.	Muslim invaders from North Africa conquer most of *metal*-rich Spain. The Muslim control of almost all of the Mediterranean coast eventually caused the eclipse of trading of *gold* and of much greater importance, the rise of *silver* in the former Western Roman Empire, such as England, France etc.
720 A.D.	Jabir or Geber, i.e. Abu Masu Dshaffar, famous Arab chemist, supposedly invented nitrate of *silver*, nitric acid, sulphuric acid and aqua regia. He was the most celebrated chemist of mediaeval times. Also known as Abu Musa Jabir ibn Hayyan ("Jabir"), he wrote the most important of the early mediaeval chemical and metal works.
732 A.D.	On Spain's northern coast, Asturias endured as the only independent Christian kingdom on the Iberian peninsula, led by Visigothic nobles. Muslim invasion of France, then Frankland or Francia, stopped forever by Germanic Frank, Charles Martel, ("the Hammer"), at Poitiers, Western France. He founded the Frankish Carolingian dynasty in Gaul.
740–796 A.D.	The value of *silver* doubled in England, in relation to *gold*. See 760–765 A.D.
745 A.D.	*Silver* mining by Germans begins at Schemnitz.
750 A.D.	Drought and famine in Spain, followed by Plague, wipe out thousands of conquering Arabs and Berbers and the conquered Christians alike.
750–903 A.D.	A base for Christian resistance is created in the forging of a kingdom of Galicia, NW Spain, against the Muslims (Moors and Berbers). Barcelona, SE Spain, slowly becomes another centre of resistance.
750 onwards	The Muslim Arabs exploit the *metal mines* of Spain and their leaders become very rich.
760 or 765 A.D.	*Silver* coins issued by Offa, King of Mercia, 757-96 A.D. are the beginning of the continuous history of English money. His reign saw the first substantial stable *silver* currency — the effective start of the *silver* "penny".
760 A.D.	The magnificent "Book of Kells", elaborate Latin gospels written and illustrated in the Irish *Celtic* manner. It can still be seen.
765 A.D.	Most likely first year of issue of the first English *silver* "penny". 240 or 250 of them

made up one "pound" weight of *silver*, (the latter still being the name of U.K. currency to this day).

768–814 A.D. Rule of Charlemagne, (Emperor Charles the Great, Karl der Grosse, grandson of Charles Martel), the German speaking Frank, who, inter alia, conquered nearly all of the German speaking lands and was the progenitor of a recreated "Holy Roman Empire" — effectively a German Empire. Learning was greatly encouraged, in religion, the arts, *metal work*, architecture etc. Prince William and Prince Henry are descendants of Charlemagne, through Diana, Princess of Wales.

772 A.D. Epidemic of disease kills 34,000 people in the Chichester area in southeast England.

779 A.D. King Offa of Mercia had eventually became King of all England, (died 796). One of the greatest Anglo-Saxon kings.

During his 39 year reign over Mercia, the value of *silver* doubled in relation to gold. King Offa did introduce a magnificent new gold coin, called a mancus, worth 30 *silver* pennies, a copy of a coin from Islam, (possibly from Muslim Spain), with the Arabic inscription faithfully copied with the words Offa Rex (King Offa) superimposed upside down. There was non-one able to tell him that the Arabic words read: "There is no god but God and Muhammad is His Prophet".

c.780 A.D. Charlemagne, 742-814 A.D., grandson of Charles Martel, sanctioned the abandonment of the *gold* standard and replaced it with a compulsory monetary system based on the denarius or *silver* pfennig or penny, which became the only important current coin in continental Western Europe for centuries. It was believed that his pfennig was originally minted in the precise size, weight and purity of the pre-Christian Roman Coin, the silver denarius.

Charlemagne liberated Catalonia (Gothalonia) Eastern Spain, stretching from Barcelona to Pamplona, from the Moors. See 750.

Celtic stone crosses appear in Ireland.

782 A.D. Construction of the formidable Saxon King Offa's Dyke, 110 miles long, against the *Celtic* Welsh attacks on Saxon Mercia.

787–795 A.D. First appearance of a serious new wave of pagan invaders, the Scandinavian Norse (Norwegian and Danish) Vikings, in Anglo-Saxon England, (by then mainly a Christianized country), and in Celtic Ireland, which by then had been Christian for over 300 years. (The Anglo-Saxons had not invaded Ireland, apart from very minor raids.)

791–803 A.D. In his raids in 791, 795/6 and 803 to destroy the pagan Avar people, (related to the Huns), who dominated Eastern Europe in the 6th and 7th centuries from what is now Southern Germany, all Hungary, as well as parts of Czechoslovakia, Austria, Yugoslavia and Romania, Charlemagne, the Frankish Emperor, brought back to Aachen, (Aix-la-Chapelle), which has the hottest springs in Northwest Europe which he loved, the immense treasure of *gold* and *silver* art objects that the Avar civilization had accumulated. The fabulous wealth was all so magnificent that it made the Franks feel that they had been poor before they won it.

However, Charlemagne did not get it all. In 1902, a hoard of Avar gold pieces as discovered in Albania in what was believed to be a treasury and workshop where the tribute in gold and *silver* paid to the Avars was melted down and turned into royal ornaments. Forty-two pieces from that discovery were sold to the American industrialist J.P. Morgan by an Austrian diplomat. In 1917, Morgan donated them to the Metropolitan Museum of Art in New York.

Some pieces surfaced again in the 1970's. More than 120 *gold* and *silver* pieces decorated with stags and scroll-like designs, made by Avar artisans for ceremonial belts such as worn by their king, fetched more than $1 million in London in 1981. It is the first time that such a major find from the European Dark Ages has been offered at auction. Existence of the pieces was not publicly known until the 1970's. The existence of the Avar treasure first became known in London in the mid-1970's when it was in private hands in Germany.

However, the greatest gifts the Avars made to Western civilization were their inventions — the extremely important stirrup (quite unknown in the West until then), the long lance and the reflex-bow, which had greater piercing power (on armour) and range than the Western at that time.

before 793 A.D. Vikings colonized Orkney and Shetland.

793 A.D. The international *silver* trade network, stretching from Spain to India, was forced to close, owing to the Arab conquests.

Because of the Muslim Arab disruption of Mediterranean trade and other events, Charlemagne continued the compulsory *silver* standard and the *silver* denarius coin, which lasted for centuries.

Lindisfarne, an Irish *Celtic* monastery island foundation and a great centre of learning off northeastern England is destroyed as Viking attacks on Britain begin. All the sacred *gold* and *silver* vessels and objects were taken away as loot. Jarrow and Iona monasteries also looted.

794 A.D. Beginning of Norse Viking invasion of Scotland.

c.800 A.D. The St. Ninian's Isle Treasure was a hoard of Pictish *silverwork*, probably buried because of Viking raids. The pieces are undamaged.

c.800 A.D. The undamaged *silver* gilt Celtic Cadboll brooch from Rogart, Sutherland, Scotland is of this date.

early 800's The West Saxons, (Wessex) became masters of all England, except for the continuing encroachments of the Vikings — who were also sometimes called "Danes" at that time. (Danish rule in their part of England, called the Danelaw, lasted only 91 years.)

800–900 A.D. Germans work *silver* mines in the ninth century in Alsace and the Black Forest and the Harz mountains. The scholarship of Irish missionary teachers in Continental Europe stood at its zenith.

815–825 A.D. Ecgbert, (Ecgberht), King of Wessex, 802-39, finally defeats the *Celtic* Britons of Cornwall. He is a direct ancestor of Queen Elizabeth II.

825 A.D. The word *silver* was first recorded in the Anglo-Saxon language under King Ecgbert of Wessex, grandfather of Alfred the Great. Ecgbert was the first Anglo-Saxon King to hold the whole of England under his overlordship, styled "king of the English (Angles) or All England". He ruled for 37 years, dying in 839. His son Aethelwulf succeeded him.

The earliest Scandinavian coins minted at Hedeby, (now in northern Germany), as thin *silver* pieces.

831–840 A.D. The towns of Dublin and Limerick founded by the pagan Danish and Norse (Viking) invaders under Olaf in Ireland.

832 A.D.	Kenneth MacAlpin, the Gaelic Scot, King of Kintyre; then 839, King of all the Irish settler Scots. He was the son of the heiress to the ancient throne of the Picts.
834 A.D.	Danish Vikings raid England again.
from 835 A.D.	Norse Vikings begin to make permanent settlements in North Scotland and weakened the Picts, whose area ran from Caithness to Fife.
843–844 A.D.	Kenneth MacAlpin was the first to unite the kingdom of the Picts (Caledonians) in East and North Scotland and the kingdom of the Gaelic-speaking Irish-origin "Scots" in South West Scotland into one kingdom, later to be called in English: "Scotland". (This unity was stimulated by the Viking attacks.)
	To this day, the sovereign of the United Kingdom, who is also sovereign of Canada, Australia and New Zealand, is crowned sitting on the Pictish royal "Stone of Scone" (pronounced Scoon) set in the Coronation Chair in Westminster Abbey, London. (This is because the Pictish dynasty is the oldest continuous rule of any royal family in Europe.) The current sovereign is H.M. Queen Elizabeth II, who is the direct descendant of King Kenneth MacAlpin and the Pictish sovereigns of the thousand years before him.
845 A.D.	Frankish King Charles the Bald pays the Viking raiders 7,000 pounds in *silver* to spare the Seine valley. Total references in Frankish sources to such payments to Vikings amount to 21 metric tons of *silver*.
849 A.D.	Alfred the Great, the Saxon, born at Wantage, Dorset in Wessex (West Saxon land).
851 A.D.	Danes land in Kent, march on Canterbury; defeated by Ethelwulf.
by 860 A.D.	All Anglo-Saxon kingdoms in England now had *silver* coins paid and accepted by tale (counting), 240 of them always being called a "pound".
864 A.D.	Gold/*Silver* Price Ratio is 1:12 in Europe; Edictum Pistense.
866 A.D.	Riding on horses, the Viking "Great Army" overwhelms the Anglo-Saxon Kingdoms of Northumbria, Mercia and East Anglia in England quite rapidly. Danes establish a Kingdom at York in 878 after capturing it in 867.
	First "Danegeld", (masses of *silver* coins in blackmail payments), paid to the Viking invaders by the Anglo-Saxons.
871 A.D.	Alfred the Great, grandson of Ecgbert and King Ethelbert's younger brother, becomes King of Wessex and later King of most of England. Resistance to the Viking settlers by the English intensifies.
875 A.D.	The Trewhiddle Treasure hoard in Cornwall, contained a *silver* and niello (see Glossary) mount for a drinking horn.
878 A.D.	At Bratton Down, Wiltshire, King Alfred defeats Guthrum the Dane, (whose *silver* coins bear his baptismal name, Athelstan) ending Danish hopes of conquering all England.
c.880 A.D.	Norse Vikings take Normandy (Norseman-dy), and settle there. Permanent Viking settlements in England and Ireland continue.
the 880's A.D.	Ample reserves of *silver* enabled King Alfred to increase the weight of the West Saxon *silver* penny to the weight of Charlemagne's heaviest coin.
before 883 A.D.	Last King of Mercia, the Anglo-Saxon Kingdom that introduced *silver* coinage to England under Penda and Aethelred.

886 A.D.	King Alfred recaptures London from the Danes. Chances of Danish rule over all England fade. (see 920 and 937). England partitioned. Scandinavian part is called the Danelaw (Danelagh).
887 (or 850) A.D.	The Fuller Brooch, a masterly piece of Anglo-Saxon metalwork, is a flat disc of *silver* that depicts the five senses, Sight, Taste, Touch, Hearing and Smell in personifications which are set off by inlays of black niello (a black alloy of *silver*, sulphur, lead and copper used to fill engraved ornaments on *silver* objects to heighten the contrast with the white *silver*) was made in the late ninth century and is in very nearly perfect condition.
895 A.D.	King Alfred defeats and captures Danish fleet.
899 or 900 A.D.	Alfred the Great, West Saxon (Wessex) King of a large part of England, dies. Direct ancestor of Queen Elizabeth II.
by 900 A.D.	*Silver* mines were worked by the Germans in the Harz mountains in the tenth century.
c.900 A.D.	Vikings living in the Norse Kingdom of York, northern England, used clothing accessories made of *silver*.
901 A.D.	Edward the Elder, Alfred's son, takes the title "King of the Angles and Saxons"; died 924.
908 A.D.	The Welsh-speaking Celtic Strathclyde (valley of the Clyde river) Britons become a dependency of the Kingdom of Scotland. (The name Strathclyde has recently been officially restored to that part of Scotland.)
910–18 A.D.	Reconquest of the Danelaw begun by Anglo-Saxons.
911 A.D.	Normandy is ceded by the King of France, Charles III, the Simple, to Rollo the Norseman, (direct ancestor of William the Conqueror Norman King of England), as a fief. The Scandinavian Viking Norse conquerors quickly come to speak French, albeit their own variation, Norman French, which survives in English speaking countries in some legal phrases.
914 A.D.	Norse Vikings conquer the southern seacoast of Ireland.
916 A.D.	One of the oldest hereditary surnames in Europe, O'Clery, came into established use in Ireland. Descendants of the O'Clerys today include the Royal Family of Sweden, through Queen Desirée, nee O'Clery, Clary or Cleary, wife of French Marshal Bernadotte, founder of the present Swedish dynasty as King of the Swedes, Goths and the Wends.
	Renewed Danish attacks on Ireland.
920 A.D.	The Danelaw, (the area of N. and E. England ruled by the Danes), finally submitted to the King of Wessex. Purely Anglo-Saxon rule over all England from this date actually lasted less than another century, and then, (after the interruption of the rule of the Danish Canute family, 1016-42), for a short second time, only 24 years, up until the Normans (mixed Norse and French) came to reign in England in 1066 under William.
926 A.D.	Approximate date of the first *silver* penny issued by a Welsh King, Hywel Dda, (Dda means "The Good"), died 950, grandson of Rhodri Mawr ("The Great"), (direct ancestor of Queen Elizabeth II), who was the first to combine all Wales.

937 A.D.	The permanence of an ENGLISH-SPEAKING England, (rather than Norse-speaking) is, in effect, settled forever by the victory of West Saxon King Athelstan at the Battle of Brunanburh, against the combined Danes, Gaelic Scots and Strathclyde (Scotland) *Celtic* Britons, (AND THEREFORE EVENTUALLY THIS SETTLED THE LANGUAGE, I.E. ENGLISH, OF THE UNITED STATES OF AMERICA, SCOTLAND, IRELAND, WALES, AUSTRALIA, NEW ZEALAND, MOST OF CANADA, PART OF THE WEST INDIES, GUYANA, MAURITIUS, AN IMPORTANT PART OF SOUTH AFRICA ETC.). The merger of Norman-French words into the basic Anglo-Saxon (English) language took 300 years from 1066 and was completed by the time of Chaucer, ca. 1360 A.D., forming our basic modern English. See 825 A.D.
942 A.D.	Malcolm I of Scotland crowned; direct ancestor of Queen Elizabeth II.
c.950 A.D.	The Islamic city of Cordoba in the *silver* mining belt in southern Spain had 300,000 people, the largest and one of the richest cities in Europe. From about this time on, the Arabic *silver* mines in Western Turkestan and Afghanistan were nearly exhausted. See 964-970 A.D. *Silver* mined in the Hartz mountains in Germany replaced the supply of *silver* from the Arab mines in the east.
954 A.D.	The Picts and Scots captured Northumbrian Anglo-Saxon Edinburgh, (now Scotland's capital). Eric "Bloodaxe", Viking King of York, expelled and York reverted to Anglo-Saxon rule. Eric was formerly Over-King of Norway. Prince Philip and Charles, Prince of Wales are direct descendants of Sigurd "the Great", King of Trondhjem, Norway, brother of Eric Bloodaxe.
959	Unification of England under Eadgar.
964–970 A.D.	Germans begin *silver* and copper mining at Goslar in the Hartz mountains.
965 A.D.	Harold Bluetooth, King of Denmark became a Christian.
970 A.D.	Printed paper money was certainly issued by the Sung government in China.
973 A.D.	Edgar, effective ruler of all England, crowned at Bath. It established the present coronation ceremony.
980's	Renewed systematic Danish raids on England. Enormous *silver* payments known as Danegeld were systematically extorted. 40,000 Arabic, 38,000 German and 21,000 Anglo-Saxon solid *silver* coins have been found on the Swedish island of Gotland.
985–86 A.D.	First Scandinavians sight North America.
989 A.D.	A Welsh King was obliged to pay a *silver* penny a head to the Vikings to redeem many of his fighting men — a large sum of money.
990 A.D.	First Irish *silver* coins issued in Dublin — *silver* pennies of Sihtric III "Silkbeard".
994 A.D.	Olaf Tryggvason, King of Norway, became a Christian.
986–1014 A.D.	*Silver* was in good supply in England. The *silver* currency was the most highly organized in Europe. Large quantities of *silver* were frequently used to buy off Danish invaders. King Ethelred II, direct ancestor of Queen Elizabeth II, used *silver* to keep England from total collapse for 30 years through 1016, when the English recognized the Danish King Sweyn (Sven) "Forkbeard", son of Harold Bluetooth, as their ruler. He died a few weeks later and his son Canute (Knut) succeeded him as King of England, Denmark and Norway. Prince Philip and Prince Charles are direct descendants of Harold and Sweyn Forkbeard. Queen Elizabeth descends from King Canute's sister, Astrid.

1014 A.D.	Brian Boru, progenitor of the O'Briens, Gaelic High King of Ireland, defeats the Danish Viking army at Clontarf near Dublin, ending forever Scandinavian interference in Ireland. Continuation of Dublin *silver* coinage, Queen Elizabeth II is a direct descendant of Brian, through two of his children.
1051 A.D.	The flow of English *silver* payments or Danegeld, to Denmark ended, as King Edward the Confessor paid off the Scandinavian mercenary troops. The weight of the English *silver* penny was immediately increased.

T.P. Mohide

January, 1985

APPENDIX III

GLOSSARY

THE LANGUAGE OF SILVER

GLOSSARY OF TERMS IN THE WORLD OF SILVER AND GOLD

About Good	Very heavily worn coin with portions of lettering, date and legends worn smooth.
About uncirculated, or Almost Uncirculated, q.v.	a coin with traces of light wear on many of the high points. Design details are very sharp with some mint lustre still evident.
Above Average (coin grade)	MS65, brilliant; MS63, more contacts than MS65; both "Uncirculated".
Absorption (Industrial and the Arts)	amount of primary silver and gold used in fabrication by domestic industries (jewellery, photography, electronics, dental, etc.)
Acid Test	the act of subjecting precious metals to specific acids, or combinations of acids, to determine the fineness of the precious metals.
Actual Cash Value	the redemption value of a contract.
Actual Silver or Gold Content	the amount of precious metal present in an alloy, given as a percentage, a fineness, or a troy weight.
Actuals	the physical or cash commodity, such as silver and gold, readily available, as distinguished from commodity futures contracts.
Ad Valorem	"on the value", used in connection with the levying of a tariff on imported metals and other goods calculated on their value.
Ag	chemical symbol of silver, from its Latin name "argentum".
Agio	word used in English since 1682 — an Italian word for "accommodation". It means the percentage of the charge made or premium, for the exchange of one form of precious metal for another form. It can also express the difference in point of value between one sort of metallic money and another.
Agitation	in metallurgy, the act or state of being stirred or shaken manually or mechanically, sometimes accompanied by the introduction of compressed air.
Airgead	the Irish and Scottish Gaelic word for silver. This word is older than any Latin. On the edge of pre-history, a king and legendary hero called Nuadhu of the Silver Hand (Nuadu Arget lám) lost his natural hand in an ancient battle in Ireland and used a silver artificial jointed limb made by Diancecht, the physician. He is known in Old British as Nodens and in Welsh as Lludd of the Silver Hand, (Lludd Llaw Ereint), whose daughter Creiddylad is the original of Shakespeare's Cordelia.
Alloy	a substance having metallic properties and being a combination by fusion or diffusion of two or more chemical elements, of which at least one is an elemental metal. Any silver or gold less than 999 purity is an alloy.

Alluvial	deposits of sedimentary material by running water, sometimes containing platinum and gold laid down in river beds, flood plains, lakes or at the foot of mountain slopes; formed by the weathering or erosion of rocks transported downstream by rivers and streams. A class of ore deposits of gold, platinum, tin, diamonds and heavy minerals contained in such deposits. See Placer.
Alluvial Mining	See Placer Mining.
Almost Uncirculated	Circulated coin grade AU-50. Traces of wear on all high points, with much Mint lustre remaining.
Amalgam	an alloy of mercury with silver or gold or other metals that is solid or liquid according to the proportion of mercury present. Most are solid. Used especially in marking dental cements. Amalgams of some noble metals occur naturally. A gold amalgam is found in nature in the region of Colombia that produces platinum. see Silver Amalgam and Argental Mercury.
Amalgamation	a process whereby gold and silver are extracted from their ores by dissolving them in mercury.
Annealing	the softening of a metal or alloy or the refining of its grain size by slowly heating it, above its recrystallization temperature, holding it at a suitable temperature and slowly cooling it at a suitable rate to remove stresses, and to improve properties or eliminate the effects of cold working, i.e. internal stresses to produce desired mechanical, physical or other properties. The annealed material is tougher and easier to process further.
Anticline	an arch or upfold in layers of rock shaped like the crest of a wave, as opposed to a syncline which is similar to the trough of a wave.
Apex	the top or terminal edge of a vein on the surface of the ground or its nearest point to the surface.
Arbitrage	the usually simultaneous purchase of commodity futures, currency, goods or securities in one market against the sale of futures in the same, or more typically, a different market in a riskless transaction in order to generate a profit by taking advantage of the price difference, (spread, straddle). A typical "arbitrage" is a purchase of metals on the London Metal Exchange and a matching sale on the Winnipeg Commodity Exchange.
Argent	1) French word for both "silver" and "money". 2) used in English for the metal silver and in heraldry for "silver". Argentum is Latin for silver and its abbreviation, Ag, is used internationally as the chemical symbol for silver. Argentina gets its name from the early shipments of silver from there to Spain.
Argental Mercury	a native Amalgam. See also Tree of Diana.
Argentariae	Roman word for silver mines. Argenteus means "silvery" in Latin.
Argentarii	Bankers ("silver traders") in Latin.
Argentiferous Lead	lead containing silver.
Argentite	a native soft, dark sulphide ore of metallic lustre and dark lead-grey colour containing valuable silver mineral (Ag_2S), also called "silverglance" because of its shiny appearance.
Argentum	in law means silver or money.

Argentum Album	in law means bullion, uncoined silver, common silver coin, silver coin worn smooth. Album means white or blank in Latin.
Argurion	another name for a silver stater. See Matthew xxvi. 15.
Argyll	a vessel of silver or other metal, like a small coffee pot, used to serve up gravy, keeping it hot. In Scottish Gaelic, Argyll, (Airer Goidel), means "the country of the Irish", named for the original Gaelic-speaking settlers who came to SW Scotland from Ireland 1,500 years ago.
Argyria	chronic silver poisoning.
Argyrol	a form of mild silver protein which is still widely used as an effective local anti-infective in medicine.
Argyros	Greek word for silver — used in English in technical words, such as cerargyrite and argyric salts.
Artemis	See Diana.
Ask	the lowest price at which a seller is willing to effect a sale.
Assaying	independent evaluation or testing of ores by chemical or other methods to determine the content of valuable metal, particularly silver and gold; a method of chemical anaylsis for determining the content of noble (precious) metals in ores, used since at least 2,000 B.C. From the Old French "assayer" — to "try" the ore.
Assay Ton	the weight in milligrams of precious metal obtained from (1) "assay ton" (AT) of ore gives directly the number of troy ounces to the net ton. The assay ton, (29,167 g.) used in assaying, bears the same relationship to the milligram that a short ton of 2,000 pounds avoirdupois bears to one (1) troy ounce.
Assessment work	the amount of work specified by law, which must be done each year to retain legal control of mining rights before grant of any title; or to unpatented claims to maintain a claim in good standing. Not required for leased or patented lands in Ontario.
Assessor	1) person learned in some particular industry or science, chosen to appraise or value property. 2) officer appointed to determine the amount of mining or other tax to be paid.
Au	chemical symbol for gold, from the Latin word "aurum", meaning "shining dawn" after Aurora, the goddess of the dawn; used for gold in English in words such as auriferous, meaning gold-bearing.
AU	almost uncirculated; coins which show very little wear.
Aurariae	Latin for gold mines.
Aureus	Roman gold coin.
Aurum Reginae	Queen's gold. A royal revenue belonging to every queen consort during her marriage with the King.
Authenticity	the actual gold or silver content in any lot in hand, authenticated by a reliable seller.
Autogenous Grinding	process of grinding in a rotating mill which uses as a grinding medium large pieces or pebbles of the ore being ground, instead of conventional steel balls or rods. See also Semi-autogenous Grinding.
Avoirdupois	weight system most commonly used in the United States (and formerly in Canada, U.K., Australia and New Zealand), for almost everything the U.S. public deals with, except precious metals and gems.

Backwardation	price differential between nearby and forward quotations when near dates are at a premium. The term used to describe a market situation where prices are progressively lower in the future delivery months than in the nearest delivery month, i.e. where there is a price differential between nearby and forward or far out quotations, when the near dates are priced at a premium because of tight supply. It is paid for delay in the delivery of the silver or gold contracted for, when the price is lower for time than for cash. Backwardation is the opposite of Contago.
Bactericides	materials that kill bacteria, e.g. silver salts.
Bag	a $1,000 bag of pre-1965 U.S. silver coins, (face value), which weighs about 55 pounds avoirdupois of metal.
Bag Marks	minor abrasions on uncirculated silver coins caused by the handling of the sealed Mint bags.
Banker	See Argentarii.
Banket	"almond cake" in the language of the Boers. The gold-bearing area in South Africa is studded with rock to fused pebbles which resembles such a cake. The gold is found thinly spread in banket — a layer of conglomerate rock that resembles grey asphalt.
Base Bullion	base *silver* bullion, i.e. *silver* in bars mixed to a greater or less extent with alloys or base metals. See Doré Bullion.
Base Metal	a term for non-precious metals that serve as a base for gold-filled, gold-plated or silver-plated materials or any non-precious metal clad or covered by a precious metal.
Base Price	silver metal value of one dollar in coin, based on the face value and weight of the coin.
Basis	1) Difference between spot or cash price and the price of the futures contract. 2) The grade of a commodity used as the standard of the contract. See Spreads.
Batholith	large mass of igneous rock extending to great depth and with its upper portion domelike in shape, the surface exposure being more than 40 square miles.
Bear	one who believes that prices will decline.
Bear Market	market where prices are falling or are expected to fall.
Bear Spread	sell front month, buy back month, when market expected to change from backwardation to contango.
Bedrock	solid rock forming the earth's crust, frequently covered by soil or water.
Bezant (Solidus)	Roman gold coin introduced by the Emperor Constantine of 65 to 70 Troy grains in weight. Was the basis of trade in the Western World from the 4th to the 12th century A.D.
Bid	highest price a buyer is willing to pay to purchase. Opposite of "offer" or "asked".
Billon (there is no second 'i')	a mixed metal used in coinage consisting of gold or silver, but with a preponderant admixture of a base metal, usually copper or tin. A typical silver billon contains 20 per cent or less of silver. In England under Edward VI the lowest content was 25 per cent silver.
Bimetallism	monetary standard where the monetary unit is defined and redeemed in two metals, such as gold and silver.

Biological Leaching	a process for the dissolution of metals from ores using bacterial action.
Bit	1) a U.S. 12½cent silver coin, long since discontinued. The U.S. silver dollar was based on the Spanish silver dollar, worth 8 reales or "bits". 2) the cutting end of a boring instrument. In rock drilling, its edge is frequently made of ultra-hard material such as diamonds or tungsten carbide.
Blank Planchet	a blank of metal intended for coinage but not yet struck.
Blast Furnance	a furnance where mixed charges of oxide or sulphide ores (of copper, iron, lead, tin etc.), fluxes and fuels are blown with a continuous blast of hot air and sometimes oxygen-enriched air to force combustion for the chemical reduction of ores with metals to their metallic state. Iron ore is most commonly treated in this way and so are some copper and lead ores.
Blast Hole	a hole drilled in rock for blasting with explosives, rather than for exploration and geological information.
Blister Copper	the product of the converting operation in copper smelting. It is a crude form of copper, assaying about 99% copper and requires further refining before being used for industrial purposes.
Block Caving	a cheap method of mining where large blocks of ore are undercut, the ore breaking and caving under its own weight.
Blowpipe	a tube used to blow air into a fire in order to raise the temperature of the fire, in the small scale smelting of metals. See Tuyère.
Boiler Room	a room where a group of fast-talking salesmen of doubtful merit phone the unsophisticated in an effort to peddle their stocks, frequently of purported mineral exploration ventures.
Bonanza	very rich ore or location or situation; from the Spanish for "success".
Boscoreale Treasure	the most sumptuous Roman silver treasure surviving to modern times. One hundred and three *silver* vases. Now mostly in the Louvre. It was buried by the volcanic eruption that destroyed Pompeii in 79 A.D.
Brazing Alloys	silver brazing alloys. See Silver Solder.
Break	a rapid and sharp decline in commodity prices.
Break-even Prices	Break-even prices are the prices at which, over a past time period, it would have been economically as rational to buy a mineral commodity in expectation of price increases as to invest an equal amount of money at the prevailing rate of interest. For the major mineral commodities — including gold — the ratios of break even prices to actual prices for the first three-quarters of the century are all higher than one. Purchase of mineral commodities in expectation of price appreciation in excess of, for instance, the AAA bond rate of interest would, for this time period, have been economically irrational.
Breakout	the action of the general market or a particular stock advancing above a level where there is indication of strong selling resistance or declining below a level where there are strong implications of buying support.
Britannia Standard	an alloy with 95.8 per cent silver, which was in compulsory use in the U.K. 1697 to 1719, but voluntary from then on; had a hallmark with the figure of Britannia.

Brockage	mirror image of one coin impressed on another.
Broker	a brokerage firm that acts as an agent for a customer and charges the customer a commission for its services.
Broker-Dealer	a brokerage firm that serves as both a broker and a dealer. It is a broker when it acts as an agent for customers and charges the customers a commission. It is a dealer when it acts as principal in a trade — that is, when it buys or sells a futures contract or a security, frequently of a mineral exploration venture, for its own account and risk and charges the customer a markup or markdown.
BU	See Uncirculated.
Bulge	a sudden advance in prices.
Bulk Metal	the term used when referring to accumulations of coins, sterling silver, scrap jewellery, and so forth.
Bull	one who expects prices to rise.
Bullion	word used in English since 1451. It means fine silver or gold, suitable for coining, in negotiable or tradeable shape, such as a wafer, bar ingot or in the lump, or sometimes as coins and jewellery, refined or partly refined. Usually 995 to 999 purity. Word literally means "melting house". The term is often applied to coin and alloys containing silver and gold only, as in the products of mines extracting both silver and gold from an ore.
Bullion Coins	coins containing usually less than 995 purity but contain sufficient fine gold to substitute for bullion, that sell at a price close to the value of the metal in the coin, having no inherent numismatic value.
Bullion Dealer	a firm whose main source of income comes from buying and selling physical precious metals.
Bull Market	market where prices are rising or expected to rise.
Bull Spread	sell back month, buy front month, when market expected to change from contango to backwardation.
Burned	slang used by clandestine smelters for melting coins.
Buttermilk Ore	German miners' name for horn silver, (cerargyrite, silver chloride), mixed with clay.
Buying Hedge	See Hedging.
Byproduct	a secondary or additional mineral or mineral product from a mine, refinery or a secondary refinery.
Call Option	by paying a premium, the buyer of an option acquires the right to decide at a later date whether or not to buy from the seller a metal or a commodity at a pre-arranged fixed price. Here the buyer expects a rise in price.
C & F	cost and freight.
Carat and Karat	The name carat comes from a Greek word karation, "fruit of the carob tree", for the carob seed, formerly used as a uniform weight. THERE ARE TWO QUITE DIFFERENT CARATS: 1) a measure of weight for gemstones, i.e. a 10-carat diamond: 2) a measure of purity or fineness in gold. Totally pure gold is called 24 carat, (or 1,000 fine) (also spelled karat).

	Carat and Karat — Definitions 1) As a unit of weight or mass for weighing precious stones, a carat is equal to 200 mg. (o.2 gram) or 3.086 troy grains — also called a "metric carat" or "international carat" since 1913. 5 carats equal 1 gram. The old carat was about 0.2053 g. (3.17 troy grains) and often ranged up to 3.33 troy grains. A carat is divided into 100 "points". Some jewellers divide a carat into four parts called "diamond grains". The U.K. symbol for "metric carat" is CM. 2) In the measure of purity of gold, to denote the quality of the metal, pure gold being 24 karats or carats, which equals 100 per cent purity; 18 karats equal 75 per cent purity pure gold; 9 karats equals three eighths pure. Usually spelled karat in the U.S.A. (See Karat Gold: alloyed gold used in jewellery.
Carrying	a general term covering both "borrowing" and "lending".
Carrying Charge Market	see Contango market or Normal market.
Carrying Charges or Costs	the costs involved in owing mineral commodities such as silver and gold over a period of time (warehouse storage, insurance, interest).
Cartwheel	slang for a silver dollar.
Cash Commodity	physical merchandise such as silver or gold available for delivery within a designated period — a commodity bought or sold to arrive — as distinguished from futures contracts based on the physical commodity; the commodity is acquired through the cash market.
Cash Market	market where transactions for purchase and sale of the physical commodity are made, under whatever terms are agreeable to buyer and seller and are legal under law and rules of the market organization, if such exist.
Cash Price	the "spot" price set or fixed at the current moment, usually daily, for the immediate settlement of transactions in silver and gold. The price can differ at the same time in separate markets.
Casting	forming objects by pouring molten metal into moulds.
Catalyst	a chemical (metal) substance which its mere presence, accelerates, assists, retards or permits a chemical reaction but remains chemically unchanged in nature or amount at the end of the reaction.
Centenario	50 peso face value Mexican gold coin, named for the country's centenary in 1921.
CFTC	acronym for the Commodity Futures Trading Commission.
CH	See Uncirculated.
Chalcopyrite	a sulphide mineral of copper and iron, being a common ore mineral of copper.
Channel Sample	a sample composed of pieces of vein or mineral deposit cut out of a small trench or channel. Usually up to 4" wide and an inch or so deep.
Chaos Hedge	See Gold Investor.
Chartist	an analyst who forecasts prices by using such information sources as charts of past prices and price movements; also referred to as a technician or technical analyst.
Chasing	a method of decorating a metal object's surface by incising it with a sharp tool.

Chervonetz	10-rouble face value Russian gold coin.
Chinese Silver	copper-zinc-nickel-cobalt alloy, with 2 per cent Silver.
Choice Almost Uncirculated, or Choice About Uncirculated	circulated coin grade AU-55. Barest evidence of light wear on a coin on only the highest relief points of the design and most of the Mint lustre still remains.
Choice Extremely Fine	Circulated coin grade EF-45. Light overall wear shows on highest points of the coin, design details are very sharp and some Mint lustre is evident.
Choice Uncirculated	an above average Uncirculated coin which may be brilliant or lightly toned and has very few contact marks on the surface or rim.
Choice Very Fine	light even wear on the coin surface and highest parts of the design, lettering and major features are sharp.
C.I.F.	cost, insurance and freight paid to destination, (included in the total price).
Cinnabar	a vermilion-coloured sulphide ore mineral of mercury.
Circulation	coins minted as legal tender and put into public use.
Cire-Perdue	see Lost Wax Casting.
Clean-up	process of reclaiming any gold or silver spilled after each "pour" or accumulated over the years in and around a reduction plant/refinery before its final closure. Can also apply to individual pieces of equipment, liners etc.
Clearing House	1) The separate agency associated with some futures exchanges through which futures contracts are offset or fulfilled and through which financial settlement is made. The Clearing House of a Commodity Futures Exchange, which trades e.g. silver or gold contracts, settles at the end of each trading day. 2) A voluntary association of banks in a city or country joined together to facilitate their daily exchange of checks, drafts and notes.
Clipped Planchet	an incomplete coin, missing 10-25% of the metal.
Coin (Historic)	a piece of precious metal intended for use as legal tender and stamped with marks or inscriptions which show that it was issued by an authority that guarantees its weight and purity.
Coin (Modern)	almost valueless piece of metal, usually not of precious metal, stamped and issued by a governmental authority to be used legally as money, usually in the small denominations of the currency.
Coin Gold	the alloy used to make gold coins, which may differ from country to country, or in different coins minted in the same country.
Coin Silver	900 parts fine silver per thousand, the other 100 parts of copper. The alloy used to make silver coins. When used as a designation on silver items in the United States, it must be 900 fine with the deviations allowed by the United States Stamping Act. See Sterling.
Coloured Golds	Karat (alloy) golds of various colours and shades can be obtained by alloying small amounts of other metals with fine gold or by using surface treatments.
Colours	the final traces of gold left in a prospector's pan.

Comex	abbreviation for Commodity Exchange Inc., New York, a hedge market for precious metals etc.
Commercial Silver	999 fine (99.9 per cent) silver, or higher. Usually sold and shipped in 1,000 troy ounce bars.
Commodity	raw materials and provisions — such as gold and silver bullion bars.
Commodity Futures Trading Commission	a U.S. federal commission regulating futures trading on all commodity exchanges to prevent practices such as price manipulation, attempted corners on the market and dissemination of false commodity and market information.
Complex Ore	an ore containing a number of minerals, one or more of which are of economic value, usually implying difficulty in the extraction or separation of the valuable metals.
Concentrate	an enriched fraction of an ore after separation from other unwanted minerals.
Concession	in surveying, one of the subdivisions of a township in certain English-speaking countries.
Conductivity	a measure of the ability of a metal to conduct an electric current.
Conglomerate	or pudding stone, in geology — a consolidated gravel or rock composed of a mixture of material (pebbles, sands, minerals) which are cemented together.
Consignment Stock	a stock of silver or gold standard bullion bars placed in the plant of a consumer, but still owned by the supplier. As the consumer requires silver or gold metal, he withdraws the desired quantity from the consignment stock at a price agreed with the supplier on that same day.
Consumption (Apparent)	amount of unwrought metal in "fabricated" gold or silver purchased by a country's residents domestically or abroad. It is calculated according to the formula: Production plus imports minus Exports plus or minus changes in stocks. See End Consumer.
Contango (or Forwardation)	price differential between nearby and forward quotation when near dates are lower than the forward quotation. A term that refers to a particular futures market situation, where prices are progressively higher in the future delivery months than in the nearest delivery month, i.e. the price differential when near dates are priced lower than forward, or far out, quotations. It is in effect the rate of interest or carrying charges on the physical gold or silver that this represents that is called a contango. Contango has been the normal situation found in precious metals futures markets during the past few decades of inflationary environment. Contango is the opposite of Backwardation.
Contract	an agreement between two or more parties enforceable by law. When applied to commodities, it is an agreement to accept or deliver a specific amount of the commodity on a certain date.
Contract Grades	the grades of a commodity such as silver or gold listed as suitable for delivery against a futures contract.
Contract Month	month where a given commodity futures contract becomes deliverable, if not liquidated before the delivery date.
Cooper's Platinum Substitute	an alloy of 70 percent silver, 25 percent palladium, 5 percent cobalt or 70 percent silver, 25 percent platinum, 5 percent nickel.
Core (Drill Core)	the long cylinder of rock, about one inch or more in diameter in exploration, recovered by a diamond drill.

Corner	1) in stocks, the concentrated ownership of a sufficient proportion of outstanding shares so that shorts may not borrow the shares except from the owner group. 2) In commodities, sufficient ownership or control of the physical commodity to control or dictate prices.
Country Rock	a loose term to describe the general mass of rock adjacent to an orebody, as distinguished from the vein or ore deposit itself. See also Host Rock.
Cross Cut	a horizontal tunnel excavated or driven across the line of strike of the ore body in a mine.
Crown	1) English silver coin of the value of 5 shillings. Originally of gold, it was first coined in 1526. Edward VI introduced silver crowns and half-crowns; also the practice of dating coins and marking them with their current value. From Charles II, crowns were struck in silver only. Minting was intermittent from 1861 and the last notable mintage was in 1927. See Double Florin. 2) synonym for the government of a parliamentary democracy with a hereditary royal chief of state, who reigns but does not rule, such as the U.K., Canada, Australia, New Zealand, etc.
Crucible	a melting vessel or pot capable of withstanding high temperatures inert to contents and atmosphere made of a refractory substance such as ceramic or earthenware material, or of a metal with a high melting point such as iridium, used for performing fusions, melting metals or other substances.
Cu	chemical symbol for copper, from "cuprum", its name in Latin. Same root as in Cyprus, a very early source of copper.
Cupel	1) a small flat porous vessel with a shallow depression in the middle, made of pounded bone ash pressed into shape by a mould, and used in assaying gold or silver with lead. 2) the similarly shaped "test" or movable hearth of the reverberatory furnance in which silver is separated from lead by cupellation. The word Cupel has been used in English since 1605.
Cupellation	1) the process of assaying or refining precious metals in a cupel. 2) the separation of silver from silver-bearing lead on a large scale in a cupel.
Current Assets	corporate assets that are immediately available, or can be made available in a short time. Cash on hand, government securities held, trade receivables and inventories and prepaid expenses that are readily marketable are included.
Current Market Value	value of an account or stock based on the closing prices of the market on the preceding business day.
Custom Smelter	a smelter or smelter-refinery which takes in concentrates, scrap or other value-bearing material from independent mines (not owned by the smelter) and which returns an agreed percentage of these materials as refined silver or gold or other metal shapes, (bar, slab or ingot). The custom smelter's profit is in his charge for this service less his costs, but he also "gains" any recovered metal which is surplus to the "returnable" amount under the contract. This operation is known as "tolling". See also Roll Refining.

Cut Value	a high assay value which has been reduced by application of an arbitrary formula.
Cut and Fill	a method of stoping where ore is removed in slices, or lifts, after which the excavated slice or lift is filled with rock or other waste material known as backfill, before the next slive is mined; the backfill supports the walls of the stope and provides a working floor for taking the next slive.
Cutting	the process of reducing the effect of high assay values by application of an arbitrary formula.
Cyanidation	extracting gold or silver by dissolving it in a weak solution of alkali metal cyanide. The gold is later precipitated from the solution by the addition of zine dust.
Daily Limit	see Limit Down.
Damascene	the inlaying of metal, usually steel, with silver and/or gold beaten into undercut grooves. Named from Damascus.
Dealer	a trader who buys and sells for his/their own account rather than as an agent for customers. A broker is paid a commission, a dealer makes profits by selling at a premium. See Bullion Dealer.
Debase	reduce the intrinsic value (bullion content) of a coin while leaving the face value untouched. Precious metals themselves are debased by alloying with base metals.
Decline	main passageway in a mine which slopes downward
Default	1) in commodities, the failure ot a party to either make or take delivery of the physical commodity as required under the contract; 2) in securities, the failure to make timely interest or principal payments on a bond or otherwise comply with any provision of the indenture.
Defective Die	coins which show raised metal from a large die crack or small rim break.
Deferred Contract	one of the more distant delivery months regarding which gold or silver futures trading is taking place.
Deflation	reduction in the value or amount of currency effecting a price decline.
Delf	a mine or quarry, (Old English). (Adam delved-dug-while Eve span.)
Delivery	the tender of the actual commodity such as silver or gold against a short position in futures during the period allowed by the futures contract, i.e. changing the ownership or control of a commodity under very specific terms and procedures established by the commodity exchange where the contract is traded.
Delivery Month	the calendar month in which the futures contract matures and within which the delivery of the physical commodity is stipulated. Also called "spot month".
Demetrius	silversmith, (faber argentarius in Latin), of Ephesus, Asia Minor, who stirred up trouble for the Christian community there because the success of the new faith was affecting the trade of those who made silver models of the Temple of the goddess Diana (Artemis). See Diana.
Demonetize	withdraw legal tender status specifically from gold or silver, generally from a coin (or note).
Denarius, Denier, Dinar, Penny	originally a Roman silver coin of pre-Christian times, with about 4.73 g. of fine silver, but copied by a number of countries, with variations on the same. Under the 3-man Consulate just before Christ, the denarius was pure silver weighing about one-

	twentieth of an ounce. The silver denarius of the Emperor Tiberius weighed 60 grains Troy or about one eight of a Troy ounce.
Dental Gold	usually 16 or 20 karats, (66.7% or 83.3% gold).
Depletion Gilding	an ingenious and sophisticated method of chemically treating an object made of a gold alloy to extract from its surface traces of all other elements except gold. When used for an alloy of silver and copper, the finished object looks like pure silver.
Depression	period of drastic decline in the national economy.
Devaluation	redefinition of the monetary unit that decreases its worth in terms of bullion or foreign exchange.
Development	the excavation work carried out in a mine to open up a mineral deposit.
Device	also called legend or inscription. It is the picture or design on a coin.
Diamond (Industrial)	the hardest mineral, composed of an allotrope of pure carbon, set into a bit for drilling holes in hard rock, set into a disc for sawing and other uses to exploit its hardness. Diamonds have a Mohs' Scale hardness of 10.
Diamond Drill	a rotary rock drill where cutting is by abrasion rather than percussion. The cutting bit is set with diamonds and attached to the end of long hollow rods through which water is pumped to the cutting face. The drill cuts a rock core which is recovered in long cylindrical sections, an inch or more in diameter.
Diana	ancient name for silver in early chemistry — from the Roman hunting and moon-goddess, goddess of virginity and child-bearing and decent women generally, the protectress and helper of women, patron of the silversmiths. Often equated with the Greek goddess Artemis. See Diana. The Temple of Diana was one of the Seven Wonders of the ancient world at Ephesus, built in 550 B.C., mentioned in the New Testament, Acts 19.24. The weight of the silver coins from the Temple of Diana were remarkably uniform at 4.7 g., like the much later electrum (silver-gold) coins of Lesbos and Cyzicus. See Luna. Lunacy is iracunda Diana in Latin.
Differential Flotation	an after-milling process for the separation of an ore from associated gangue or waste rock, whereby more than one valuable mineral is floated and separated, one from the other, as well as from the waste constitutents of the ore.
Differentials	premiums paid in the market for grades better than the basic grade or discounts allowed for lower grades.
Dilution	Incorporation of low grade mineralization or waste rock with ore during mining operations.
Dinar	see Denarius.
Disagio	discount needed to dispose of minerals or other goods taken in countertrade (barter deals).
Discount	in futures trading, where the price for future delivery is lower than a purchase today.
Disseminated Ore	ore in which small particles of valuable minerals are spread more or less uniformly through the gangue matter; distinct from massive ore wherein the valuable minerals occur in almost solid form with very little waste material included.
Dollar	silver dollar — see Real.

Doré Bullion	an impure alloy of gold and silver, typically produced at a silver or gold mine. From French, 'gilded'; Latin deaurare (de-aurum). Aurum means "gold". A crude alloy of gold and a significant amount of silver or silver bullion containing a small amount of gold. In U.S. usage, doré bullion is synonymous with Base Bullion, crude lead with recoverable silver, with or without gold.
Doré Silver	crude silver that contains some gold.
Double Eagle	a U.S. gold coin of face value $20. An Eagle was a $10 gold piece, hence the name Double Eagle.
Double Florin	a U.K. silver 4-shilling coin. See Crown.
Double Option	gives the buyer or person taking the option the right either to buy from or sell to the seller of the option or the person who gives it, at the basis price.
Doubloon	Spanish gold coin, originally double the value of a pistole. The doubloon of Chile, 900 fine, weight 7.62 g, was worth 5 Chilean silver dollars a century ago.
Drachm	in Apothecaries' weight, 8 drachms equal 1 ounce (Troy).
Drachma	name for certain ancient and modern Greek coins. A silver drachme of Antioch is translated as "piece of silver", Luke XV. 8, equivalent to a Roman silver denarius, weighing about one-eight of an ounce. Originally the name described small iron skewers used in Greece for heating meat and later as money and later as a currency silver coin in pre-Christian times. Our English word "dram" derives from it — used by dispensing pharmacists — but not with the same weight, and also as slang for an alcoholic drink.
Dram	one-sixteenth of an ounce avoirdupois. This dram is not the same as the Apothecaries' drachm: see Drachm and Drachma.
Drift	a horizontal tunnel mined parallel to the strike.
Ducat	term in inscription on coins in 12th century Venice, Italy and later used for many others. See Sequin.
Ductility	property or quality of metals, alloys etc. by which they may be beaten into thin sheet or drawn into wire or extruded without rupture. (Gold is the most ductile metal at normal temperatures.) See Malleable.
Duro	Spanish word for a silver dollar, originally meaning "hard", echoing the concept behind the "solidus", a Roman imperial coin.
dwt.	abbreviation for "pennyweight", q.v.
EFP (Exchange for Physical)	a trade between two parties where one of the parties buys the physicals and sells the futures contracts, and the other party sells the physicals and buys the future contracts. Such an EFP is made up of four parts: 1) the purchase and 2) sale of futures contracts coupled with 3) the simultaneous sale and 4) purchase by the same two parties of an equal quantity of the physical commodity. Such transactions may be mutually agreed upon by the two parties to the transaction.

Elasticity (Economic)	describes the interaction of the supply, demand, and price of a commodity; "demand elasticity" — when a price change creates an increase or decrease in consumption; "supply elasticity" — when a change in price creates change in the production of the commodity.
Electric Furnace	The electric induction furnance (developed in 1916) is used to produce silver, gold and platinum group alloys. It is particularly useful where close control of temperature, cleanliness and the surrounding atmosphere is mandatory.
Electrolysis	Chemical decomposition of a substance by an electric current passed through the substance where the metal is deposited by the passage of a direct electric current on a cathode from a solution or molten mass. Process used for refining precious and other metals.
Electroplating	a thin layer of precious or other metal of varying thickness and fineness is deposited into another material such as base metal by passing an electrical current to electrodeposit the precious metal onto the base metal. Patented in 1840 in the U.K. by Elkington, it replaced Sheffield Plate, q.v.
Electrum, Electron	argentiferous (silver-bearing) gold — a very pale yellow natural alloy of gold containing 26 to 40 per cent silver, occurring naturally as gold ore. Authorities differ on the percentage. It is also mixed artificially. The colour ranges from pale yellow to pure white depending on the amount of silver present. The name is derived from the pale yellow colour of electrum, which resembles that of amber (elektron). It was regarded by the ancients as a white variety of gold, which is near the truth. (Early, i.e. pre-Christian, samples of platinum were thought to be electrum.)
Element	a substance which cannot be split into anything simpler in a chemical process.
Embossing	a technique for decorating sheet metal by pressing or hammering a design in relief.
End Consumer	a company in whose hands the identity of fabricated metal, say silver, is finally lost in a more complex product, such as switchgear in dishwashers and other products.
Epithermal Effect	phenomenon, not acceptable as universal by all observers, whereby the deeper one mines in the earth's crust, the less silver is found. Epithermal describes a hydrothermal mineral deposit formed within about one kilometre (3,280.833 feet) of the Earth's surface, occurring mainly as veins.
Erosion	breaking down and subsequent removal of either rock or earthy surface material through natural forces.
European Depository Receipt	a substitute stock certificate that makes it easier for a citizen of one country to own stock in a firm located in another country. Essentially the same as an American Depository Receipt (ADR), except the owner of the EDR is usually not a U.S. citizen.
Evening Up	buying or selling to adjust an open market position; also called "off-set".
Exchange	1) any place where business is carried on by brokers; generally refers to one of the major stock or commodity exchanges; 2) currency of the country.
Exchange Rate	relative value of one currency in terms of another.
Ex-Dividend	"without the dividend." The buyer of a stock selling ex-dividend does not receive the recently declared dividend.

Exergue	part of the reverse of a coin between the device and the bottom edge.
Exploration	prospecting, diamond drilling and other work involved in searching for ore.
Extremely Fine (XF)	slightly circulated coin with most lustre remaining and only faint evidence of wear, such as very fine hairlines partly obliterated.
Fabricated Gold	worked gold.
Fabricator	a company which makes fabricated or semi-fabricated products such as wire, cable, tubes, strip, rods, etc. from refined metals and occasionally from scrap.
Face Value	or nominal value. Monetary value of a coin, paper money or other currency as imprinted, stamped or marked on that unit, fixed by the government of the country of origin for use as legal tender.
Farthing (Fourthing)	coin valued at a fourth of a penny. Regular part of the coinage from Edward I, 1239-1307. The farthing was originally of silver and down to the reign of Mary, (died 1558), remained a silver coin. Britain discontinued the bronze farthing in 1970.
Fault	a break in the earth's crust caused by forces which have moved the rock on one side of the fault with respect to the other.
Federal Funds	reserves traded among U.S. commercial banks to enable them to maintain their legally required reserves. U.S. Federal funds are usually traded overnight.
Federal Funds Rate	interest rate at which banks lend federal funds to each other.
Federal Reserve Note	a note issued by a U.S. Federal Reserve Bank, e.g. a U.S. dollar bill.
Federal Open Market Committee (FOMC)	this committee sets U.S. Federal Reserve guidelines regarding purchases and sales of government securities in the open market as a means of influencing the volume of bank credit and money. This in turn has an effect in Canada, in investments in mineral ventures etc.
Ferric	trivalent iron.
Ferrous	1) containing iron. 2) bivalent iron, as opposed to ferric, q.v.
Fiat Credit	credit based on an abstract idea or theory rather than physical assets or commodities.
Fiat Money	money which a government declares shall be accepted as legal tender, but which is not covered by any available precious metal specie reserve. It is inconvertible and irredeemable.
Fiduciary	person who is legally authorized to manage and control part or all of another person's property, including precious metals.
Field	portion of a coin which is not filled in with a device or inscription.
FIFO	an accounting term meaning first in, first out. The opposite of LIFO: last in, first out. Both are used in valuing inventories of precious metals.
Filigree	delicate tracery in fine gold or silver. Consists of silver or gold wire twisted and soldered in patterns on a background. It has been used in jewellery since about 2,500 B.C.
Fine (F)	circulated coins with no lustre and with noticeable wear which are slightly worn on the edges but shape in all details such as letters.

Fine	the millesimal designation of the purity of a precious metal as a number in relation to 1000 parts. See Fineness.
Fine Gold	gold grain or bullion of specified quality, (e.g. 995 parts gold per 1,000). Pure gold is 24 carats. There is virtually no such thing as 24 karat jewellery. It would be far too soft and would wear away.
Fineness	Fineness is the measure of silver or gold purity, measured either in karats, or the weight fraction of precious metal contained, expressed in 1,000ths in jewellery alloy applications. 24 karat is pure gold. An 18-carat gold alloy might be described as of 750 fineness, i.e. 750/1000ths., (18/24ths.), consists of the main precious metal, gold. To take another example, 900 fine gold has 900 parts of pure (fine) gold and 100 parts of an alloying metal or metals, which means it is 90% pure gold. Fineness is a ratio of pure metal to total weight. In bars and coins it is usually expressed as a decimal percentage, e.g. 999.86 parts fine.
Fine Ounce	a Troy ounce of “pure”, (actually in practice 999/1000ths pure), precious metal.
Fine Silver	pure silver, 1,000 parts fine or 999.5 parts (or higher) per thousand of silver. Sometimes used for “at least 99.9 per cent silver”.
Fine Weight	the actual weight of the pure gold or silver contained in a coin, ingot, bar or other item with a precious metal content, determined by multiplying the gross weight by the fineness, as opposed to the item's total weight, which includes the weight of the alloying component.
Fiscal Policy	government policy regarding taxation and spending.
Fiscal year	the accounting or budget year, as distinguished from the calendar year.
Fissure	an extensive crack, break or fracture in rock; may become the site of a vein.
Fix (Fixing) (Silver and Gold Fixings)	the setting (in London) of the price at which the authorized dealers (merchant banks) have bought and sold gold and silver published daily on trading days. The London Gold Bullion Market and the London Silver Bullion Market fix the prices daily (the AM and the PM fix).
Flange	a raised rib or rim reinforcing part of an object.
Float (Geological)	rock pieces that have been broken and moved from their original location by natural forces such as frost action or glaciers.
Float (Securities)	to sell a new issue of securities. Also applies to the floating account of a bank which holds outstanding out-of-town cheques in the process of collection.
Floor Broker	a member of an exchange who transacts business for another member of the exchange.
Flotation (Heavy Media Separation)	process in which ore is separated from gangue, (earth and rubble), during which the ore is introduced to a bath of agitated special liquid so the metallic ore fraction either rises or sinks to the bottom and the gangue does the opposite.
Flux	a non-metallic substance that facilitates the melting and flowing for joining metals in soldering. Removes the oxide from the surface to facilitate the bonding of the metal and solder and protects from further oxidation during soldering More important use is in smelting and refining of many metals, i.e. a substance used to react with gangue to form slag. Also materials used in laboratory fusions.
F.O.B.	free on board — all shipping costs paid up to the point at which the shipping conveyance leaves for its destination, or in the U.S., up to its destination.

Fool's Gold	iron pyrite veins in hard rock, often mistaken for gold. Real gold so found would be soft; iron pyrite is hard and brittle.
Footwall	the lower side, or floor or an orebody fault, vein, or a seam etc. or of workings in a mine. Usually the term for the lower contact of a dipping ore body and the rock (waste) mass below this contact; the host rock underlying the orebody.
Force Majeure Clause	a clause in a supply contract which permits either party not to fulfil the contractual commitments due to events beyond their control, ranging, for example, from strikes and natural disasters to export delays in producing countries.
Foreign Silver	contains varying amounts of silver. In some cases the fineness is as low as 700 parts per thousand.
Forwardation	see Contango.
Forward Contract	a cash market transaction in which two parties agree to the purchase and sale of a commodity at some future time.
Forward Metal	silver or gold contracted for delivery at some forward or precise future date.
Fossilis	adjective in Latin for "mineral". Fossor means miner or digger. Metallicus frequently, when a miner of metals.
Fracture	In mining terms, a break in the rock mass of the earth. The opening provides an opportunity for entry of mineral bearing solutions or vapours.
Franchise	1) a privilege extended to an individual or corporation by a governmental body, empowering the recipient to do something that otherwise would be illegal, such as to operate without competition from other operators. 2) a commercial contract to market a good, usually under carefully controlled conditions, often with uniformity, amongst franchisees.
Free Coinage	law or policy which provides that all who deposit silver and gold bullion at the Mint are entitled to receive in exchange coins of equal weight, less minor charges.
Free Gold	1) see Free Coinage; 2) occurrence of gold in its native state, i.e. "native gold".
Free Milling	term used to describe gold or silver ores from which precious metals can be recovered by methods not involving unusual or complicated treatments.
Free Silver	1) free coinage of silver. See Free Coinage. 2) In the U.S., free silver came to mean that portion of the Treasury's stock of silver not needed to back "silver certificates", one form of a U.S. dollar bill, which is no longer issued.
Frosted Silver	a film of pure silver left on the surface after a copper-silver alloy has been heated and dipped into hot dilute sulphuric acid.
Frustration of Contract	the abandoning of a contract when the fulfilment of the contractual commitments become quite impossible.
Full Value	the value of a precious metal alloy, item or coin before taking into consideration wear and assay and refining costs.
Fundamental Analysis	an approach to market behavior that stresses the study of underlying supply and demand factors.

Futures (Contracts)	a commodity contract is a commitment which requires delivery or receipt of a commodity at an agreed future date, at an agreed price established by public auction in the trading pit in an organized public commodity exchange, i.e. a hedge or futures market, and subject to all terms and conditions included in the rules of that exchange.
Future Exchange	membership organization involved in public trading sessions in commodities listed for trading futures contracts.
Galena	lead sulphide ore mineral which almost always contains varying amounts of silver. Most of Europe's silver is from galena.
Gangue (pronounced "gang")	the rock and/or that portion of the minerals in an ore deposit that is/are worthless
Gatherer	a person or firm involved in the purchase of scrap precious metals.
Geber or Jebir	See Appendix II, 720 A.D.
Geiger Counter	an instrument used to measure radioactivity by means of a Geiger-Mueller tube. It detects the gamma rays and indicates the frequency or intensity either visually by dial or flashing light, audibly by earphones or both.
Geology	the group of sciences concerned with the study of the rocks which compose the earth.
	Organized geological knowledge and treatises began with the Germans Agricola, (Georg Bauer), and K. von Gesner. William Smith is the acknowledged "grandfather of modern English geology".
German Silver	Nickel Silver, q.v. — composed of nickel, copper and zinc, with *no* silver.
Geophysical Survey	scientific method of prospecting that measures the physical properties of rock formations such as magnetism, specific gravity, electrical conductivity and radioactivity.
Gild or Geld	money or tribute in Anglo-Saxon law.
Gilded Gesso	gesso is a paste of gypsum and glue used to prepare surfaces for painting or gilding or used to cover imperfections on a wood surface and then gilded.
Gilding	to cover or overlay with a thin layer of gold which is then said to be "gilt". Also meant "to pay taxes", e.g. "This town, Ilfracombe, in the Confessor's days, (11th. Century), guilded after one Hide, and one Farthing of Land".
Gilding Metal or Gilding Brass	an alloy containing 5 to 10 percent zinc, composed of 4 parts of copper, 1 part of Bristol old brass and 14 ounces of tin to every pound of copper;
Gilt or Gilded	covered or overlaid with a thin coating of gold — gold laid on the surface. A base metal dipped in a gold solution or deposited with a very thin gold electroplate.
Gilt Jeweller	one who specializes in such gilding.
Glacial Drift	sedimentary material ranging from clay to boulders which has been transported by glaciers.
Glacial Striae	lines or scratches on a smooth rock surface caused by glacial abrasion. The singular is stria. Compare striated and striation.
Gold	the native metal; element commonly found associated with silver and to a lesser extent with copper and other metals in natural occurrences.

Golda	a "mine" (Old English) — Blount.
Goldbeaters Skin	the traditional material for goldbeaters skin used to produce "gold leaf" is ox-gut, a layer of the caecum or blind gut of the intestine. The fine gold is placed between two liminated layers of ox-gut which have been specially varnished and then the beating commences, continuing until the gold leaf is only 0.1 micron thick. This ox-gut was probably never produced in the U.S.A. Prices were steep. The use of ox-gut in goldbeating was given up in the States many years ago. There were very few goldbeaters left. It is a difficult skill. Nowadays, cellophane or glassine is used. The largest firm of goldbeaters in the world was M. Swift and Sons Inc. of Hartford, Connecticut. They still had some ox-gut available in 1970 and could supply the cellophane or glassine.
Gold Bullion	fine gold in bar form.
Gold or Silver Certificate	certificate attesting to a person's ownership of a specific amount of silver or gold bullion paid for, in store.
Gold (III) Chloride. (Auric, trivalent, Chloride)	used as a toner in photography and when dissolved in hydrochloric acid, as an electrolyte in the Wohwill process for refining gold.
Gold Dealer	synonym for a member of the London Gold Bullion Market.
Gold Delivery Bar	a bar of a nominal 400 troy ounces (12.44 kg.) of 995 fine gold.
Gold Dust	fine particles of gold, such as obtained in placer mining.
Gold Electroplate	a thin coating of karat gold is applied to a base metal by electrical current; it must be at least 7-millionth of an inch thick.
Gold Exchange Standard	device evolved at the Genoa monetary conference, 1922, after the collapse of the Gold Standard during World War I, to maintain the stability of currency exchange rates. Under this system Central Banks redeemed their currency not in gold, as before, but in a currency that is convertible into gold. The system collapsed 1931-33, but was revived after World War II and during the period 1958-71 most European treasuries adopted this approach, treating the U.S. dollar as the main unit in which to accumulate reserves.
Gold Filled (GF is the abbreviation)	"Gold Filled" in Canada and the U.S.A. is a layer of at least 10 karat gold mechanically bonded under heat and pressure to one or more surfaces of a supporting base metal or alloy, then rolled or drawn to a prescribed thickness. In the U.S. jewellery industry, the quantity of karat gold must be at least 1/20th by weight of the total metal content. If it is less than 1/20th, it is "rolled gold plate". See "Rolled Gold". Under U.S. regulations, a jewellery product fashioned of "gold filled" material may be marked, described or advertised as 14, 12 or 10 karat gold filled. ("gold fill"). See "Rolled Gold".
Gold Fixing	London Bullion Market sets (fixes) the gold price and announces it publicly.
Gold Flashed	also gold-washed. A thin film of gold applied to a base metal, as in electroplating, but with less than a seven-millionth inch thickness of karat gold. See Gold Electroplate.

Gold or Silver Investor	person convinced that part or all of his assets should be in the form of physical silver or gold bullion or coins. See also Chaos Hedge.
Gold Leaf	thin gold foil produced by beating gold ribbon placed between vellum and animal skins or substitutes until the gold leaf is only 0.1 micron thick. Used for coating artificial satellites etc. to reflect infrared radiation, as well as for decorative gilding such as on picture frames, in lettering and bookbinding.
Gold Overlay	also known as gold plate and rolled gold plate. These terms as gold plate and rolled gold plate. these terms can be used as markings on gold-layered products without a fractional prefix only if the gold weight is at least $\frac{1}{20}$ of the total weight of the metals.
Gold Parity	value of a currency unit expressed in milligrams of fine gold.
Gold Plate	see Gold Overlay.
Gold/Silver Ratio	the number of ounces of silver it takes to buy one ounce of gold. It has averaged 32:1 over the last 100 years.
Gold Spreads	see Bull Spread, Bear Spread.
Gold Standard	a country is said to be 'on the gold standard" when the monetary standard unit of its currency is defined by law as a fixed quantity of gold and when its currency is freely convertible at home or abroad into that quantity of gold. Monetary system in which the value of currency in issue is legally tied to a certain quantity of gold. During the last quarter of the 19th century virtually all major trading nations adopted this policy and most attempted to return to it after the break caused by World War 1. This attempt was abandoned, in all important cases, with the onset of the world economic slump in 1931. Most countries have had sharply modified versions of the gold standard. The United States abandoned the gold standard in 1974.
Good (G)	coins which are quite worn but have a plainly distinguishable basic design and clearly discernible date. Design, legend, and date are clear, but not sharp. All points of detail worn smooth.
Good Delivery bar (or "good London delivery bar")	the standard gold bullion bar meeting the standards set by the London Gold Bullion Exchange that is traded internationally, weighing 350-430 troy ounces (nominal 400 troy ounces, about 12.44 Kg.) of fine gold, minimum 995 parts per 1,000 fine gold. The "free market" price is paid on the gold content only, basis 1,000 fine.
Grab Sample	a sample taken at random; it is assayed to determine if valuable elements are contained in the rock. A grab sample is not intended to be representative of the deposit and often the best looking material is selected.
Grade	amount of silver, gold or uranium or other metal per metric ton of ore, expressed in grams or kilograms respectively, i.e. the standard set for judging the quality of a mineral, metal or commodity.
Grain (gr.)	the smallest and fundamental Anglo-Saxon unit of measure of weight, (originally the equivalent of one grain of wheat or barley), which is common to the avoirdupois, Troy and apothecaries systems, equivalent to almost 64.8 milligrams. 480 avoirdupois grains equal one Troy ounce. 7,000 grains equal one pound avoirdupois.
Gram (g)	fundamental unit of mass in the metric system, CGS version, equal to one-thousandth of a kilogram. 1 gram equals 15.4324 grain.

Granulation	a method of decorating the surface of a metal artifact with tiny spheres of gold.
Gray Gold	gold with a little iron and 8.6 percent silver.
Gresham's Law	a 1558 theory, "bad money (e.g. paper currency) drives good, i.c. silver and gold, out of circulation into hiding", of Sir Thomas Gresham of London, 1519-1579, that when paper or coins of equal face value, but different intrinsic value, are put into circulation together, the coin with the higher intrinsic value will be hoarded and only the lower intrinsic value paper or coin will continue in circulation. Actually earlier economic writers, notably Oresme and Copernicus had set it out quite ably, but Gresham was a high-ranking advisor to the British Government who managed to raise the value of the pound sterling on the Antwerp "bourse", discharging virtually all of King Edward VI's debts.
Grivna	an ancient Russian silver coin equivalent to about one pound of silver.
Groat	heavy English silver coin issued as early as 1279. Groot was Dutch for "big".
Gross National Product (GNP)	the total monetary value of a nation's output of goods and services during a given period. It is regarded as the broadest measure of a nation's economic condition.
Gross Spread	the dollar difference between the price which the issuing exploration or mining company receives for its securities and the price which the public pays for those securities. Sellin concession + underwriting fee = gross spread.
Growth Stock	(mineral) company shares that show a steady increase in gross earnings and usually plough back a fairly large percentage of their net for expansion, exploration and research.
Gross Value	theoretical value of ore determined simply by applying the assay of metal or metals and the current market prices; it represents the total notional value of the contained metals before deduction of recovery losses, mining and smelting costs; it must be used only with caution and severe qualification.
Gross Weight	the total weight of a coin or of bullion.
Grubstake	finances or supplies furnished to a prospector in return for an interest in any mineral discoveries made.
Guinea	a gold coin formerly issued by the British Royal English Mint. The gold came from Guinea. They were all called in during the reign of William IV, (died 1837). Value: 1.05 pound sterling.
Hack Silver	silver objects reduced to scrap by being chopped into small pieces before refining. In ancient times, these small pieces were often used as a substitute for coinage.
Halfpenny	A British coin, first minted in silver in 1280. In 1324, it could buy 4 pounds of flour; in 1400 12 eggs and in 1637, 2 mutton chops. It remained silver until 1672, when it was changed to pure copper. Long since a bronze coin, it was withdrawn permanently in 1984. See Penny.
Halides	see Silver Halides used in photography.
Hall Mark (Hallmark)	authenticating marks struck on silver or gold articles; a protection for the consumer of gold or silver: the official marks or stamps used by gold and silversmiths in England, Scotland and Ireland in marking gold and silver articles assayed by the guilds. It signifies that the article is made of precious metal of a certain fineness and the year of manufacture and the maker.

Halogens	the four elements Fluorine, Chlorine, Bromine, Iodine which readily unite with metals to form "salts". See Silver Halides.
Hanging Wall	the host rock overhanging an orebody. The upper side, or roof, of fault/orebody in workings in a mine. Opposite of Footwall, q.v.
Hard Currency	see Strong Currency.
Hard Money	money in the form of solid precious metals, i.e. gold, silver and platinum coins and bullion bars.
Haulage	the operation by which the ore is hauled to the shaft.
Haulageway	large tunnel in a mine through which ore is hauled.
Heavy Gold Electroplate	similar to gold electroplate, but the finish must be at least 1-ten-thousandth inch thick.
Hedge (Hedging)	the establishment of an opposite position in the futures market from that held in the physicals. Hedging is the sale of futures against the purchase of inventory of actuals, or the purchase of futures against forward sales of the physical commodity as protection against a price advance. It reduces the risk, protecting a company or individual from price fluctuations. Without hedging, the physical position would be at risk to price fluctuations.
Hg	chemical symbol for the metal mercury. See Hydragyrum.
High Fine Silver	contains at least 99.95 per cent silver.
High Grade	rich ore. As a verb, to selectively mine the best ore in a deposit.
Highgrader	one who steals rich ore or metal occurring in nature, especially gold, from a mine.
Highgrading	the practice of stealing gold or other valuable ore, (in mining vernacular). See Highgrader. Also a mine operator removing higher grade material faster than economic optimal.
Holder	buyer of a silver option contract.
Hoard	a collection of treasured objects, usually of gold or silver, buried secretly and discovered later, usually centuries later.
Horde	originally a term for a Turko-Mongol regiment and by association, their camp; has come to mean an innumerable swarm in English. The Golden Horde ruled Russia in the Middle Ages.
Horizon	plane of a geological formation.
Horn Silver	a silver-bearing mineral, $AgCl$, cerargyrite.
Host Rock	rock in which an ore deposit occurs.
Hydragyrum	mercury. Word still in use in English in the pharmacopoeia. Hydragyrism is mercury poisoning. See Amalgams.
Igneous Rocks	rocks formed by the solidification of molten material that originated deep within the earth.
I.M.F.	International Monetary Fund, an organization of 138 countries, headquartered in Washington, D.C. It promotes stabilization of international currencies.
Incline (or Inclined Shaft)	a mining shaft that is not vertical, often following, approximately, the dip of the reef or plunge of the orebody.

Index	a measurement of market price movement based on prices of a fixed selection of securities and weighted according to the number of shares outstanding for each security.
Induced Polarization	ground geophysical surveying method employing an electrical current to determine indications of mineralization.
Industrial Minerals	a somewhat misleading term, whose meaning normally includes non-metallic minerals which are used in industry and manufacturing processes, usually in their natural state such as asbestos, salt, sand, gravels, talc, mica etc.
Inflation	a condition characterized by a rapidly rising price level and active business during which time profits are high in monetary terms, but the purchasing power of money steadily diminishes, always associated with increases in the money supply.
Ingot	a word of French origin for a bar of metal cast from a mould. Rarely used now in English for standard gold or silver bars. The modern French is lingot.
Inside Information	information that has not yet been made public.
In Situ Ore	in ore reserves — ore reserves in place prior to mining — no allowance made for mining loss or dilution = geological reserves.
Interim Financing	financing during the time from project commencement to closing of a permanent loan or equity financing.
International Depository Receipt (IDR)	same as an American Depository Receipt (ADR) except this is usually owned by a person who is neither American or European, perhaps Asian.
Inverted Market	synonym for Backwardation market. A commodity futures market where the nearer months are selling at premiums over the more distant months; characteristically a market in which metal supplies are in shortage.
Investment Dollars	dollars in London that are available for the purchase of dollar securities.
Invisible Supply	uncounted stocks of a commodity in the hands of wholesalers, manufacturers and producers which cannot be identified accurately, but theoretically are available to the market.
Ir	chemical sumbol for Iridium.
Iridium	a rare precious metal — one of the six platinum group metals.
Iron Pyrite	see Fool's Gold.
Isotope	Greek for "same place", (same position in the periodic table of the elements). Isotopes are atoms which are different varieties of the same element, having the same atomic number and possessing almost identical chemical and physical properties, but varying in atomic weight only because of differing numbers of neutrons in the nucleus. Such elements are mixtures of different isotopes. Hundreds of isotopes have been identified, including radioactive ones. Isotopes have been manufactured in the laboratory.
Issue	bonds, stocks or other obligations marketed for a corporation and constituting one of its liabilities.
Jebir or Geber	See Appendix II, 720 A.D.

Jeweller's Rouge	red ferric oxide, often in a tallow base. Used to polish gold and other precious metals. Also called Jeweller's Red Rouge or Plate Powder.
Jewellery Gold	ranges from 9 to 22 karat (37.5% to 91.5% pure gold). See karat gold.
Junk Silver	U.S. silver coins with no numismatic (collectible) value.
Junk Sterling	a sterling artifact that holds no value, other than its 92.5% silver content, because of damage or poor craftsmanship.
Karat	see Carat.
Karat Gold	Karat gold is gold alloy used in jewellery and is designated by a karat number. (Pure (Fine) gold is too soft to use in jewellery. It would wear away too quickly.) The addition of other metals to gold, forming alloys called "karat gold", adds strength, hardness and/or colour and other desirable physical qualities. Fine gold is 24 karat, (commercially 99.9% pure). The most popular "karat golds" are 22, 18, 14, 12, 10, 9 and 8 karat. "22 karat gold" consists of 22 parts fine (pure) gold and 2 parts other metals. "18 karat gold" equals 75 per cent fine gold, 25 per cent other metal. It consists of 18 parts fine (pure) gold and 6 parts other metals, frequently 3.6 silver and 2.4 copper. "14 karat gold" is a 58.3 per cent gold alloy containing 14 parts fine gold and 10 parts other metals; popular in Continental Europe for wedding rings. The most popular quality in the U.S. "12 karat gold" is 12 parts fine gold and 12 parts other metals; "10 karat gold" is 10 parts fine gold and 14 parts other metals. In the U.S.A. no quality of less than 10 karat, with its allowable tolerances, may be described as karat gold, or even be called gold at all. "9 karat gold" is the legal minimum in Canada and in the U.K. and Ireland. The U.K. industry provides 9 karat gold jewellery and it is exported to Canada. "8 karat gold" is legal in Germany. The Italian market prefers 18 karat gold jewellery. The legal minimum that can be called gold in France and Italy is 18 karat (750 fine). The U.S. and Canadian market generally prefers 14 karat gold jewellery. The legal minimum that can be called gold in the U.S.A. is 10 karat. The West German market prefers 8 karat gold jewellery, which is the legal minimum there. 22 karat is the permanent favourite in the Middle and Far East.
Kerb Trading	unofficial trading when the market has closed. "Kerb" dates from the time when dealers continued trading on the kerb outside the exchange after trading hours.
Kilo Bar	a 32.15 troy ounce bar of fine gold (1.00 kg.).
Kilogram	a metric weight unit of 32.1507 Troy ounces equivalent or 2.20462 pounds avoirdupois.
Lacus	alloy of silver with a base metal, in old English law.
Laissez Faire	non-interference, especially the doctrine that government should not interfere with

(“let them do as they please”)	commerce.
Lakh	means a quantity of 100,000. A term from India. Used in professional silver trading for convenience, e.g. ‘I want 1 lakh’ means I want to purchase 100,000 ounces of silver.
Lamination	1) process whereby precious metal is bonded onto a base metal, or 2) a flaw of less than 25% peeled off a coin’s surface.
Last Trading Day	final day for trading a particular delivery under a commodity exchange contract. Positions not closed by the last trading day must be fulfilled by making, or taking, delivery of the physical commodity.
Laterite	a residual red ferruginous clay soil found in tropical countries caused by the weathering of basic igneous rocks.
Lator	gold coins of the former Latin Monetary Union (LMU) of 1862. Term used mainly for Italian or Belgian coins of nominal value, 20 lira or 20 Belgian francs.
Layered Metal	a metal item in which gold or silver is used as a finishing surface on a base metal, such as gold or silver plated or clad.
Leaching	a chemical process for extracting (dissolving) valuable minerals from ore in a solution.
Leaseback	practice whereby a company or individual sells a property and then leases it back from the new owner.
Legal Tender	whatever is declared by statute to be acceptable as legal satisfaction for the repayment of debts and the fulfilment of contracts denominated in money.
Leopard’s Head	the English assay mark on a silver object certifying that is at least 92.5 per cent silver. Actually it is a lion’s head, but heraldry rules in 1300 demanded that only a lion rampant was a lion. In any other position, it was a “lionne leopart”, in Norman-French. See Hallmarks section.
Lettered Edge	edge of a coin which has an inscription around the edge.
Level	denotes the workings in a mine at various depths, analogous with floors, (storeys), in a building.
LIFO	last in, first out. The last shipment received before taking inventory may be considered the first sold. Opposite of FIFO.
Limit Down; Limit Up	certain limits set by a commodity exchange on the maximum fluctuation the price may make during a particular time — usually a day. For example, silver traded on the Comex, New York cannot move more than $0.50 per ounce in either direction in one trading day. (There is no limit on the London Metal Exchange.)
Lion Dollar	Dutch silver coin bearing the figure of a lion, current in New York in colonial times.
Liquid Assets	assets, including gold and silver bars, which may be immediately turned into cash.
Liquidation	closing out of a long position, in contrast to covering, which refers to closing out a short position.
Liquid Gold	liquid containing about 12 per cent gold and sometimes a little rhodium created by mixing gold with certain chemicals for use in decorating porcelain and glass with gold designs. It is painted on the object and then heated to 540 degrees Celsius. The resulting coating of gold is only 0.1 micron thick, (0.00004 inch).

Liquidity	the degree to which a high percentage of assets which may be quickly converted to cash.
Liquid Market	a market where selling and buying can be accomplished with ease due to the presence of a large number of interested persons willing and able to trade substantial quantities at small price differences.
Lira, Lire	much devalued unit of Italian currency, which originally denoted one pound of silver.
LME	acronym for the London Metal Exchange.
Loco	place at which a certain metal lies, or will be delivered. For example, you may hold silver "loco London".
Lode	a mineral deposit in solid rock. Lode metal is gold or silver which occurs in a vein. A "reef" is a lode of gold-bearing quartz. "Lode" is a line or aggregation of metal or mineralized rock in veins or ledges in a continuous belt or zone embedded within the solid quartz or other rock "in place" where it has been deposited. The areas in this country and the U.S.A. that are at all likely to contain valuable lode deposits of gold have already been explored carefully and thoroughly. The individual prospector without ample capital has a marginal chance of discovering a lode rich enough to be worth developing. "Lode" is from the Old English "to lead". (Compare the words lodestone; lodestar.). Lodestone was magnetite ore used as a compass. "They have now two kinds of Tynne workes, Stream and Load. When they light vpon a smal veine, or chance to leese (lose) the Load which they wrought, — they begin at another place neere-hand and so drawe by gesse to the main load againe." –Carew, "Cornwall," A.D. 1602.
London Delivery Bar	see Good Delivery Bar.
Long	a trader whose net position shows an excess of purchases over sales; referring to a cash or futures position. A buyer who is holding securities or commodities in anticipation of a price rise; a position opposite to a short.
Long Ton	2,240 pounds avoirdupois.
Lost Wax Casting	a casting technique from prehistoric times still in use that uses a wax model as a matrix for shaping the mould; also called cire perdue, which is French for lost wax.
Lot	1) standard contract unit on a regulated market. A "silver lot" is equivalent to 5,000 troy ounces on Comex, New York. 2) in surveying, part of the subdivision of a township.
Luna or Lunia	ancient name for silver, Latin for the moon, often said to be silvery. See Diana, patroness of virginity and childbirth as Lucina.
Lunar Caustic	silver Nitrate mixed with nitre.
Magma	molten material deep in the earth from which rocks are formed. When it pours out at the surface it is called lava.
Magnetic Separation	a process in which a magnetically susceptible mineral is separated from other minerals by applying a strong magnetic field.

Malleable	characteristic of a metal or alloy allowing it to be rolled or hammered into a thin sheet without cracking. Gold is the most malleable of all metals. See Ductility.
Managed Currency	currency not anchored to gold, but controlled or manipulated by the government in an effort to secure a predetermined price level.
Management Fees	a fixed fee and/or percentage of the gross spread which accrues only to the manager.
Mancus	1) an Anglo Saxon gold coin worth 30 silver pennies. 2) a weight of gold of about 70 grains.
Maple Leaf	the world's second best selling investor's and collector's gold bullion coin, as at 1984, which was first minted in 1979. A very pure gold coin, .9999 ("four 9's") containing 1 troy ounce of gold, with a face value of $50, which is purely nominal. There are now available smaller "Maple Leaf" coins of ½ounce and onetenth of an ounce of gold.
Margin	an amount deposited with their brokers by investors as buyers or sellers of futures contracts to ensure performance on futures contract transaction commitments. Margins usually average about 5 per cent of the dollar value of the contract. (Serves as a performance bond and not as a down payment.) The holder of the contract has to provide promptly the difference between the current market price and his contract price by paying "variation margin" differences.
Margin Call	a commodity broker's request to an investor/client for additional money to add to and secure the original deposits, to bring margin deposits up to the required minimum. a margin call is triggered by adverse price movements before the contract's delivery date.
Maria Theresa thaler	A 1780 Austrian silver coin 83.33 per cent pure silver, 42.5 mm in diameter — still the actual money in circulation in many parts of the Middle East, greatly preferred over paper money.
Mark	1) originally a measure of weight, comprising 8 ores in Denmark, (possibly of Scandinavian origin) — variable, but approximately 8 troy ounces of gold or silver — throughout Western Europe. In England the mark was money of account only, brought in under Danish rule. After the Norman Conquest it was equal to two-thirds of a pound sterling, 160 silver pennies (pence). 20 pence was equal to one troy ounce of silver. 12 ounces equalled 240 pence, one troy pound of silver, i.e. one pound sterling. Under Henry I, 1100-1135, 1 gold mark was worth 720 silver pennies or 9 silver marks. A silver mark was worth 80 silver pennies. The mark (merk) Scots was a silver coin from 1570. The new 1873 German mark, replacing the thaler (dollar), was a silver coin, based on gold. The mark remains the name of the currency in Germany, (the rentenmark, reichsmark and the deutschemark in this century). The silver Ransom demanded by Austria for the release of King Richard Coeur de Lion (Lionheart) of England in 1194 was 150,000 marks or 800,000 troy ounces, all of silver. The ransom weighed about 25 metric tons. (At U.S. $7.00 an ounce, this would now be worth about U.S.$5.6 million). Richard died of wounds in France at the age of 42 having been King of England for only 10 years. He was succeeded by his brother, King John of Magna Carta fame, direct ancestor of Queen Elizabeth II.

	2) stamping on gold and silver products that shows fineness, manufacturer's trademark, type and other indications as required by U.K., Canadian, United States etc. laws, as applicable.
Market	1) prices at which a security or commodity can actually be bought or sold; 2) locale where a security or commodity is known to be traded.
Market Risk	the risk current interest rates may rise and thus adversely affect current commodity market prices.
Market Value	current or prevailing price of a security or commodity as indicted by current market quotations.
Matte	metallic compound with sulphur.
Maundy Money (also Maundy coin)	coins of 92.5% (standard) silver still struck by the Royal Mint, London in relatively small number for distribution by Her Majesty the Queen personally to the poor aged over 60 years of age on Maundy Thursday each year on the day before Good Friday, at Whitehall.
Melt and Assay	the policy of a refiner to melt and test an alloy before making a settlement on purchases of precious metals.
Melter	means the refiner of the precious metal.
Mercantilism	economic theory much favoured in the 16th and 17th Centuries, under which a country's prosperity was held to depend on its success in accumulating gold and silver reserves. It favoured strictly limited imports and aggressive promotion of export trade. Emphasis on government guidance of economy. Most of today's policies are called neo-mercantilistic.
Mercex	abbreviation for the New York Mercantile Exchange, a hedge market for precious metals, etc. See Nymex.
Merchant Bank	the type of financial organization in England that combines the functions of a commercial bank with those of an investment banking firm. They do not deal with the public.
Mercury	quicksilver. Hydragyrum, "silver that flows like water". Name from the Roman god, identified with Hermes, a Greek deity. A silver-white metal with brilliant metallic lustre, which is liquid at ordinary temperatures. It has the peculiar property of readily absorbing other metals such as silver and gold.
Metal	a chemical element which is a good conductor of heat and electricity and readily forms positive ions.
Metallic Standard	money system that defines and redeems the monetary unit in terms of a fixed metal amount.
Metallurgy	A term of wide meaning, embracing the practice and science of extracting metals from their ores, the refining of crude metal, the production of alloys and the study of their constitution, structure and properties and the relationship of physical and mechanical properties to thermal and mechanical treatment of metals and alloys.
Metamorphic Rocks	rocks that have undergone a change in texture or composition from their original form through such agencies as heat, pressure or chemical action.
Metric	decimal system of measurement involving grams, kilograms, millimeters and meters — widely used for precious metals.

Mexican Dollar	the excellence of the Mexican silver dollar, or peso, rendered it a favourite coin in all countries and gave it much of the character of an international coin.
Mill	the plant in the reduction works where the ore is crushed and ground and a concentrate produced by flotation or gravity separations.
Millhead	the grade of ore entering the mill.
Milling Ore	ore that contains sufficient valuable mineral to be treated by a milling process.
Mina, Maneh	ancient weight unit for silver, about 11,239 grains Troy, (over 1 lb. 11 oz.) worth 50 shekels among the Hebrews. Translated as "pound" in Luke xix. 13.
Mine	word of Celtic origin in English and French; the old word "meini", meaning ore or metal, from which the modern Welsh word mwyn (ore or mine) and the Irish mein are derived. Royal Mine or Mine Royal — English law, any mine yielding more gold and silver than will cover the operating costs. The law in England has followed Roman imperial law concerning gold and silver mines. Mines Royal are the exclusive property of the Crown, i.e. the government; (until 1760, the King of England himself). Virtually all gold and silver mines in the U.K. are in the Celtic areas — an interesting coincidence.
Mine Production	means the content of the utilizable ores-concentrates.
Minerals	"minera" in Latin means ore or a mine. Naturally occurring homogeneous substances or material obtainable by mining, having definite physical properties and chemical composition and, if formed under favourable conditions, a definite crystal form.
Mining	extracting economically important minerals and ores from the earth.
Minor Coin	small denomination coins which have little bullion value.
Mint	facility where coins are manufactured. (See Money.)
Mining	act of manufacturing coins in a mint.
Mint Mark	mark on a coin — often too small to read — which identifies the Mint at which it was struck.
Mint State	MS — synonymous with Uncirculated; describes coins showing no trace of wear.
Mocha Dollar	or piastre, the former silver unit of value in Arabia.
Monetary	pertaining to coinage or currency or having to do with money, but it has been held in the U.S. to include personal property.
Monetary Policy	U.S. Federal Reserve actions that influence the cost and availability of money and credit in the U.S.A. This in turn affects investments in mineral ventures in Canada.
Money	"Moneta" in Latin. Originally the name of a goddess in whose temple at Rome money was coined — hence our words "money" and "mint". Anything that is accepted as a circulating medium of exchange. 1) strict technical sense: coined metal, usually *gold* or silver. 2) more popular sense: any currency, coins, tokens, bank-notes.
Moneyer	person who makes coins.
Monopoly	the power to control prices within an industry or exclusive possession of the trade in some commodity by virtue of being sole purveyor of a commodity.

MS	uncirculated coin grade. See Mint State.
Multinational	a company that has operations centres in many countries.
Multiple Strike	a coin with an additional image from being struck a second or more times approximately 80% off centre. Value increases with number of strikes.
NASDAQ (National Association of Securities Dealers Automated Quotations)	subsidiary of the NASD owns and operates a computerized communications system that stores up-to-the-second price quotations from a U.S. nationwide network of dealers for more than 3,000 OTC (over the counter) securities, some of them mineral exploration ventures.
Native Silver	silver found occurring in nature in the pure metallic state, notably in Norway and Cobalt, Ontario, Canada.
Nearby Delivery	the nearest active traded contract month of a delivery on a commodity futures exchange.
Net Asset Value	a per share valuation of a mutual fund based on total assets minus total liabilities.
Net Free Reserves	funds member banks may use to expand loans and investments.
Nickel Silver	a series of alloys of nickel, copper and zinc. The most common alloy contains 20 percent nickel and 5 percent zinc. They contain *no* silver. Also known as German Silver. In 1963, Inco listed over 70 Trade Names for nickel silver, including Colorado Silver, Nevada Silver, New Silver, Silverine, Silverite, Carbondale Silver, etc.
Niello	a fusible black alloy of silver, sulphur, lead and copper, used to fill engraved ornament on silver objects to heighten the contrast with the white silver. See Damascene.
No-Load	sold at net asset value.
Nominal Price	declared or estimated price for a futures month used to designate a closing price when no trading has taken place during the final few minutes of the trading session. Usually the average between the last bid and the last asked price.
Nominal Value	(also face value). Value of a silver coin etc. fixed by country of issue for use as legal tender. See Face Value.
Normal Market	See Contango.
Note	a promise to pay as distinguished from an order to pay.
Notice Day	a day when notices of intent to deliver on futures contracts may be issued.
Nugget	a water-worn piece of precious metal found in nature, usually implying some size.
Numismatics	relating to the hobby or occupation of collecting coins and related items. From the Latin numisma, a coin, from nummus, the name of an old coin.
Numismatist	coin collector.
Nymex	abbreviation for the New York Mercantile Exchange, a hedge market for precious metals etc. See Mercex.
Obverse	side of a coin bearing the principal design; the two sides of a coin are called obverse and reverse.

Odd Lot	an amount of stock less than the established trading unit, (board lot), usually less than 100 shares.
O.E.C.D.	Organization for Economic Cooperation and Development. Formed in 1961 with 24 countries, it seeks to further world economic development. For example. it agreed to set limits through 1985 on the importation of oil.
Off Centre	approximately 10-20% of design missing from obsolete type coins; 20-60% missing from modern coins.
Offer	price at which someone will sell a commodity or a security. Opposite of "bid".
Offset	liquidation of a purchase through the sale of an equal amount. (See Evening Up.)
Oligodynamic Effect	effective in small amounts, from Greek oligas, small and dynamis, power. Silver in small amounts in medicine is extremely effective. In ancient times, man discovered that water stored or carried for any length of time in silver vessels remained purer for longer periods than in earthenware or other containers.
Omnibus Account	an account carried by one futures commission merchant with another where the transactions of two or more persons are combined rather than designated separately and the identity of the individual accounts is not disclosed.
One-sided Market	a market consisting of only a firm bid or a firm offer.
Open-End Fund	funds that have no fixed number of shares outstanding.
Open Interest	the total number of "open futures contracts" of a given commodity recorded on the books of a commodity exchange that have not yet been offset by opposite transactions nor fulfilled by delivery. It refers to unliquidated purchases or sales and *never* to their combined total.
Open Market	a broad and freely competitive market.
Open Outcry	oral declaration of each trade on an organized futures exchange, by calling out bids and offers and acceptances across a ring or pit. The deal is thereby fixed on acceptance and that price becomes the latest traded price for that delivery date of the mental, say silver.
Open Position	a forward market position which has not been closed out.
Opportunity Cost	the cost of pursuing one course of action measured in terms of the foregone return offered by the most attractive alternative.
Option	a privilege or right to buy or sell specified securities or commodities at a definite price within an agreed-upon time.
Or	signifies gold in English in heraldry, (the French word for gold).
Ore	A Danish coin of silver equivalent to 16 or 20 Anglo-Saxon silver pennies. 8 ores made up 1 mark.
Ore	a native mineral containing a precious or useful metal or metalliferous minerals in such quantities and in such chemical combination as to make its extraction profitable or a mixture of valuable ore minerals and gangue from which at least one of the metals can be extracted for profit. It has three parts, 1) the host or country rock, q.v.; also dilution or waste.

	2) the gangue, q.v. and 3) the desired mineral itself.
Ore Dressing	treatment of ore by removing some of the waste material and thus concentrating the ore mineral.
Ore Reserves	the prime measured assets of a mine as to tonnage and grade that can be extracted at a profit at current prices and at current technology, in the near future. Resources may be classified as proven, probable, possible or speculative. They may be estimated as geological reserves, in situ or allowing for mining losses and contamination by country rock — recoverable resources.
Original Margin	1) initial deposit of margin money required to clearing member firms by clearinghouse rules; 2) initial margin deposit required by customers by exchange regulations.
Ormolu	a golden coloured alloy of copper and tin, with or without zinc, used to imitate gold. Ormolu is used in decorating clocks, furniture etc. From the French "or moulu" meaning "ground gold". It is often gilded by brushing with gold amalgam and then firing.
Ounce	1) Troy — equal to 31.1035 g. (same as the Apothecaries' ounce). 2) Avoirdupois.
Outcrop	geological formation or structure which is exposed at the earth's surface, or is covered only by surficial deposits. Line along which the reef breaks the surface at ground level.
Out of Line	generally used when an order cannot be executed on account of difference in price level between the order and current market prices.
Overbought	a technical opinion that the market price has risen too steeply and too fast in relation to underlying fundamentals.
Oversold	a technical opinion that the market price has declined too steeply and too fast in relation to underlying fundamental factors.
Over-the-Counter (OTC)	this market is not a specific place, but is the process whereby parties negotiate trades by telephone and the market is made by dealers.
Oxide	a chemical compound of oxygen and a mental or other element.
Pale Yellow	Gold with 8.3 percent silver and a similar amount of iron.
Palladium	a rare metallic element of the six platinum group metals.
Pan	to wash in a pan, gravel or sand, or rock samples that have been ground to small particles in order to separate gold, platinum or other valuable heavy metals or minerals.
Paper Profits	unrealized profits.
Par	1) price of 100%; 2) face value assigned by a corporation to common or preferred stock; 3) the principal amount or denomination at which the obligor (issuing corporation) contracts to redeem the bond at maturity.
Parent Company	a company owning sufficient stock of another company to be able to dictate or control its decisions.

Parity	1) foreign exchange; value of one currency in terms of another as determined by their respective gold backing; 2) commodities; price level at which two delivery points are equalized, after shipping, interest and insurance expenses have been adjusted.
Participating Preferred	a preferred stock which is entitled to regular dividends and participates in company earnings which sometimes means additional dividends.
Par Value	1) bonds: value originally received by the issuer and amount due to investor at maturity; 2) stocks: face or nominal value, the amount is engraved on the face of the certificate.
Payable	ore that can be mined at a profit.
Pay Limit	ore grade below which mining is unprofitable.
Pd	chemical symbol for palladium.
Pegged Price	price at which a commodity has been fixed by agreement.
Pegging	1) attempting to keep a market within a certain range. 2) in Australia, staking a claim.
Penny	originally an Anglo-Saxon, (originally spelled "paenig", "penig" or "penning") and German silver coin derived from the denarius, q.v. In England, a gold penny was also issued in 1257 and 1265 under Henry III. In 1324, a silver penny could buy 8 pounds of flour; in 1400, 24 eggs and in 1637 4 mutton chops.
Penny Stocks	low-priced issues, usually under two dollars a share, highly speculative.
Pennyweight	originally, in England, (from the 700's to about 991 A.D.), the actual weight, (24 Troy grains), of a sterling silver penny coin. The silver penny, much debased, was not finally withdrawn until after the last minting in England in 1816. The pennyweight is still used as a unit of measurement of weight, (one-twentieth of a troy ounce), in dentistry, for example, and consists of 24 Troy grains. Abbreviated as "dwt". there are gold karat alloy "pieces" in the dental world in North America which are sold by the pennyweight, (dwt.), and which are occasionally loosely called "gold Pennyweights". There is a long list of the various combinations of the specific gravity required in the alloy, the thickness and the size of the piece. As a completely random example, a "piece" of such an alloy could be from .002 mm. to .001 mm. thick and say 12 mm. square. in the jewellery field, 18K to 14K gold is sold by the pennyweight either in grain form or in sheet of about 3.175 mm. thick, which is easily cut up into pieces.
Peso	a Spanish word for silver dollar, originally meaning "weight".
Pewter	a poor man's silver. An alloy of tin, with copper, lead and other metals.
Pieces of Eight	see Real.
Piedfort	a special striking of coins on double thick blanks — frequently of silver.
Pillar	blocks of ore or waste rock left intact to act as supports for shafts or other underground workings. Some pillars may be extracted as a final stage of mining.

Pillar Dollar	silver coin of Spain, bearing the figure of the Pillars of Hercules, formerly current in the Spanish colonies in America. The two vertical strokes in our dollar sign come from this coin.
Pit	1) the place on a North American commodity exchange floor designated for the execution of futures orders for a specified commodity, such as silver. Known as a "ring" or "trading ring" in London, England. 2) Old English word for a mine and still used for deep shaft mines there. Used in North America in a more limited way, as in "sand pit" and "open pit."
Placer (or Alluvial)	a Spanish word from Catalan, (Barcelona area), used in English in mining. Catalan is a Romance language related to the Provencal speech of Andorra and the Pyrenees of Southern France. Pronounced approximately "plass — er". Placer consists of all forms of alluvial or diluvial mineral deposits such as gold and platinum which are loose and *not* "in place", i.e. excepting veins, lodes or seams. It is a concentration of some sought-after natural material carrying one or more of the precious metals that has accumulated alluvially in the unconsolidated sediments of a stream bed or sea shore through the process of weathering or erosion. Heaviness and resistance to corrosion make platinum and gold ideal substances to accumulate in. placer deposits close to the source rocks from which they have come and make recovery by gravity separation feasible. In addition to these properties, the bright characteristic yellow colour of gold and the shine of platinum, makes them easily recognizable even in very small amounts. ALMOST EVERYONE HAS SEEN MOVIES OF THE OLD TIMERS "PANNING" FOR (PLACER) GOLD IN THE STREAMS OF THE KLONDIKE IN THE YUKON, CANADA. PLACER IS STILL RECOVERED FROM THE JUNGLES OF COLOMBIA. In the Yukon, Canada, in Alaska and in the Siberia/Far East Regions of the Soviet Union, the gravels containing the gold placer are perennially frozen and nowadays are thawed out by steam jets or wood fires. "deposits of valuable minerals found in particles in alluvium or diluvium'. Lindley: American Law relating to mines and Minerals Lands' 1914. also: "potentially commercial deposits of detrital natural material containing valuable material in the form of discrete grains". Unconsolidated but may be indurated. AIME Mining Engineering Hand Book, 17-151. includes: pebble phosphates in Florida, sea bed nodules, Diamonds, Cassiterite, Rutile, Selacilite, titaniferous iron beach sands.
Placer Claim	a mining claim located on gravel or ground whose mineral contents are extracted by using water or sluicing. The U.S. unit claim is 1320 feet square and contains 10 acres.
Placer Deposits	a mass of gravel, sand or similar material resulting from the crumbling and erosion of solid rocks by the action of wind or water and containing particles or nuggets of gold, platinum or other valuable minerals and infrequently silver that have been derived from rocks or veins.
Placer Mining	form of mining where surface deposits are washed for gold or other valuable minerals. The earliest and best known form of placer mining is gold panning, as seen in the movies on the Yukon gold rush in Canada etc.

Plata	Spanish word for silver.
Plate	derived from plata, above; means articles made of solid silver.
Plating	the deposition of a layer of metal on an object forming the cathode during electrolysis. See Electroplating.
Platinum	a silver-white precious metal that was used as an adulterant for gold a century ago, but is now usually more valuable than gold. Its name derives from the Spanish word platina, meaning "little silver". They thought it was a variant of silver. See Plata.
Platinum Group Metals	platinum, palladium, rhodium, iridium, ruthenium and osmium.
Platinum-Silver	an alloy of 66.7 percent silver and 33.3 percent platinum. See Silver-Platinum.
Plumb Gold	karat gold that is plumb with the karat mark stamped on the product. 14K plumb stamped 14K is 14K.
Pool	combination of persons organized to exploit the market in certain stocks or commodities. A joint venture of the participants. During its existence the members usually agree not to trade separately for their own account. All capital is pooled.
Porphyry	any igneous rock where many relatively large, conspicuous crystals are set in a very fine-grained ground mass or matrix.
Portfolio	loans and securities held by a corporation or individual.
Position	market commitment.
Position Limit	maximum number of specultive futures contracts one can hold aas determined by the U.S. CFTC and the exchange where the contract is traded.
Position Trading	a trader either buys or sells futures contracts for metals and holds them for an extended period.
Pot	slang for the slag ladles used for a crucible used for melting metal and holding molten metal.
Pound (weight)	1) Troy — 5,760 grains — legal in the U.S.A. 2) Avoirdupois — the normal pound weight in use in e.g. the kitchen.
Pound	Anglo-Saxon unit of currency; 240 to 250 silver pennies made up one pound. It continues as the U.K. currency unit to this day. The first pound coin was introduced in 1489 by Henry VII. It rose to prominence during the English Civil War in the 1640's when Royalists camped in Oxford periodically melted down college silver to mint their own bulky currency. The new U.K. base metal 1-pound coin of the early 1980's costs 0.25 pound to produce. The pound had declined to below U.S.$1.11 in value by January 14, 1985.
Premium	1) in options, the amount paid for the "right" to buy or sell a commodity such as silver at a prearranged price. In silver it is in pennies per ounce, so that the cost of one warrant of silver in London is 10,000 times the quoted premium. 2) bonds or preferred stocks: excess of the market price over par; 3) new securities offerings: market price excess over price at which the securities were offered by the underwriters;

	4) also redemption price of a preferred stock or bond if that price is above the face value or par value.
Pressure Burst (Rock Burst)	sudden bursting of rock, commonly with a partial closure of the working place, due to gret pressure at depth in the mine.
Price Earnings Ratio (P/E)	market price of a stock divided by its latest available or estimated earnings per share.
Primary Silver or Gold Metal	a term which refers to unworked silver or gold, usually bullion or grain, newly won from mining operations.
Prime Rate	fee that banks charge their biggest borrowers with the best credit ratings.
Principal	1) one who acts as a dealer buying and selling for their own account; 2) face amount or par value of a debt security; amount of money used as an investment.
Private Placement	issue sold to one or a few investors as opposed to being publicly offered and sold.
Profit and loss Statement	summarizes income and expense of an organization to show net profit or loss for the fiscal period involved.
Profit Taking	liquidating a paper profit to realize cash profit.
Proof (PR)	coins specially struck by mints for collectors which are in perfect, mirror-like condition. They were struck much slower than ordinary coins.
Prooflike (PL)	uncirculated coin so perfect that it resembles a proof.
Prospectus	issued by a corporation when new securities are offered and given to prospective purchasers; contains detailed information about the company's business and financial standing.
Proxy	written authority given by a stockholder to some other party giving the other party the right to vote the stock at a stockholder's meeting.
Pt	chemical symbol for platinum.
Purchase and Sale Statement (P&S)	a statement sent by a commission house to a customer when his metal futures position has changed, showing number of contracts involved, prices where the contracts were bought or sold, gross profit or loss, commission and net profit or loss.
Pure Gold	gold of 999 fineness or 24-karat gold, with no alloying metal.
Pure Silver	silver of 999 fineness, with no alloying metal.
Purity of Gold	usually expressed as parts of 1,000, so that a "fineness" of 800 means 80 per cent gold.
Purple of Cassius	hydrated stannic (tin) oxide containing finely divided gold. It has been used for centuries for preparing purple glass and enamel.
Put Option	an option giving the buyer the right to sell a certain amount of metal at a specified price within an agreed-upon time.
Pyramiding	using paper profits as the basis of additional margin with which to finance the purchase of more stock. Also applies to the piling of one holding company on top of another.

Pyrite	a common sulphide mineral, hard, shiny and usually of a pale yellow colour, composed of sulphur and iron; sometimes known as "fool's gold". Gold and copper are often associated with it.
Pyx, Trial of the	test of the purity of the alloy in English coins of silver or gold.
Quality	degree of credit worthiness of a security or issuer, commonly noted by the rating given to a security.
Quick Assets	assets that are readily marketable.
Quickground	ground in a loose, incoherent state.
Quicksand	sand which becomes shifting, easily movable or semiliquid when infused with water from below and subjected to a load or vibration.
Quicksilver	see Mercury, a metal with a liquid form at ordinary temperatures. See also Amalgam.
Quotation	price in a market; not necessarily the purchase or sale price, but an indication of market levels.
Raise	a vertical or inclined opening in a mine which has been opened from its bottom upwards.
Raising	1) a technique for shaping hollow vessels by hammering the sides of a flat metal sheet or disc upwards. 2) in mining, the process of opening a raise, a method of excavating an opening in a mine from a lower to a higher elevation.
Rally	expression for a short, but spirited, market upturn.
Real (plural: Reales) pronounced 'ray-al', as in pal	a small Spanish milled edge silver coin, with 3.54 g. or about one-tenth of an ounce of fine silver. A real was called a "bit" by Americans; "2 bits" meant 25 cents. A larger coin worth 8 reales or "bits" was known to English speakers as a "piece-of-eight" or "dollar", which was largely used as legal tender in the Spanish-American and English colonies in America at the time of their revolt. In fact it was legal tender in the U.S. until 1857. Still familiar becuase of the pirate stories, particularly "Treasure Island" by Robert Louis Stevenson, the Scot. It was chosen as the standard for the U.S. silver dollar coin in 1792, except that the 92.5 per cent silver content was changed to 90 per cent, to make the coins wear better. The U.S. content was 0.77 Troy ounce of silver. The silver dollar of Philip II of Spain (Armada, 1588 bears among his other titles, that of "King of England", which he did not succeed in enforcing.
Reconnaissance	preliminary mineral exploration.
Recovery	percentage of valuable metal in the ore that is actually recovered by metallurgical treatment.
Redeemable	paper money that can be exchanged for bullion or intrinsic value coin at a fixed exchange rate.
Red Herring	preliminary prospectus giving advance details of an expected offering of corporate securities, subject to amendment, with the sale contingent on clearance by the SEC. So called because it has a disclaimer printed in red.
Reduction	the removal of oxygen or similar anion from a chemical compound or oxide ore in order to produce metal.

Reduction Plant	ore treatment works where ore is milled, a crude or refined form of gold or silver extracted and dispatched to the central refinery.
Reef	a metalliferous mineral deposit, especially gold-bearing, commonly in a sedimentary rock, e.g. banket in South Africa. A reef is a line or ridge of rock below the surface in a thin but wide seam. The term is also used for tabular quartz veins — e.g. saddle reefs which follow the bedding in anticlines..
Reef Width	thickness of the actual reef, exclusive of waste.
Refinancing	retirement of existing securities and issue of new ones to save interest costs, consolidate debt, lengthen maturity or otherwise alter company capitalization.
Refined	precious metals that have been worked to remove the precious metals from the alloying metals and improve the purity of the precious metals. Refined production includes quantities produced from scrap.
Refinery	facility where precious metals are refined.
Refining Silver	silver between 99.6 and 99.9 per cent pure and practically free from gold.
Reflation	re-expansion in the money supply.
Refunding	redemption with funds raised through a new issue sale.
Registration Statement	documents including a prospectus with exhibits prepared primarily by the issuing company, its counsel and independent accountants with the help of the management underwriter and their counsel.
Regulation T	prescribes the amount of credit which U.S. brokers and dealers may advance to their customers.
Reserve (Ore Reserve)	that portion of a resource that has been actually discovered, outlined and measured but not yet exploited and which at present is technically and economically feasible. The in-place demonstrated (measured and indicated) mineral resource currently seen to be usable.
Resource (mineral)	a concentration of naturally occurring solid, liquid or gaseous materials in or on the earth's crust in such form that economic extraction of a commodity is potentially feasible, but is by no means certain. See Reserve.
Restrike	when a government produces a new minting of an out-of-issue coin using the original dies.
Revaluation	redefinition of the monetary unit that makes it worth more in terms of bullion or foreign exchange.
Reverse	See Obverse.
Rh	chemical symbol for Rhodium.
Rhodium	a rare precious metal — one of the six platinum group metals.
Riffle	a groove in the bottom of an inclined trough or sluice, for arresting gold or other heavy metals contained in sands or gravels that are washed down the sluice.
Ring	the official trading arena on the London Metal Exchange, where the dealers sit in a ring of benches. Equivalent to "pit' in North America, where the traders all stand.
Roasting	treatment of ore by heat and air, or oxygen enriched air, or other reagent, to eliminate volatile substances and bring about chemical changes such as oxidation of sulphides.

Rock Burst	see Pressure Burst.
Rolled Gold	gold-clad base metal is defined in Canada and the U.S.A. as "rolled gold". Same basic requirements as for gold filled, at least 10K gold layered on a base metal, but if the gold in this surface alloy is less than 1/20th of the total weight of the metal, the specific percentage of karat gold should be indicated clearly. It is sometimes referred to as "gold plate" or incorrectly as "gold filled". It should be identified as such either as "R.G.P." or as a fraction indicating the quantity of gold, (1/40 12K RGP).
Rouge	see Jeweller's Rouge.
Round Turn	the completion of both a purchase and an off-setting sale or vice versa.
Royalty	a share of the gross money receipts or the profits due to the King or government ("Crown royalty" in Canada), or to an owner of mineral rights under a contract, for the right to work them.
Rupee	Name of the currency and formerly a silver coin in India derived from a root meaning "silver", (rupiyah in Hindi and rupiah in Indonesia). The Indo-European Sanskrit word rupya means "wrought silver".
Salt	1) an ionic compound usually containing a metal and a non-metal, formed by replacement of hydrogen by the metal in an organic acid. 2) addition of mineralised material or chemicals or metal to an ore sample prior to assay either incidentally or in order to obtain falsely high assays.
Sampling	selecting a fractional but representative part of an ore or process material for analysis.
Sandstone	a medium-grained sedimentary rock composed of mineral or rock fragments which have cemented together. Most sandstones consist predominantly of quartz.
Sceat, Sceatta	the earliest Anglo-Saxon silver coin from about the late 600's A.D. Of less denomination than a silver shilling. 20 sceattas were worth one Kentish silver shilling. 4 sceattas to a Mercian shilling. The West Saxon (Wessex) shilling contained 5 pence.
Schilling	the modern Austrian currency. In Old High German, a skilling was a gold coin. See Shilling.
Seat	a membership on a stock or commodity exchange.
Secondary Market	previously issued securities are traded here.
Secondary Metal	precious or other metal recovered from recycling scrap etc., usually at a secondary refinery. A term which refers to gold or silver obtained from the processing of scrap, slimes, sludges etc. A significant portion of the gold and silver supplied to the market place is "secondary" metal.
Securities and Exchange Commission (SEC)	an independent U.S. government agency that provides the public with information and protection in the securities and financial markets. It regulates the issuing of securities and supervises all national securities and associations. Detailed information on certain major Canadian mining companies producing precious metals is also obtained from the SEC in its 10-K Reports, q.v.
Sedimentary Rocks	secondary rocks formed from material which is derived from other rocks transported by and usually laid down under water, (or less commonly air or ice), for example, limestone, shale, sandstone, tillite.

Seigniorage	minting fee or profit taken by a government that is obtained from the difference between the intrinsic value and the face value of standard coin.
Selling Hedge or Short Hedge	See Hedging.
Semi-fabrication	production of gold, silver or other metal or alloy in the form of wire, sheet, rod etc.
Sequin	Venetian gold coin called ducat or "sequin", from which the English word sequin derives, i.e. circular coin-like reflecting pieces sewn in hundreds on expensive dresses, producing flashes of reflected light as the wearer moves. See Ducat.
Sesterce, Sestertius	originally quite a small silver coin, weighing 18-15 grains, meaning "two and a halfer", (2.5 "asses"), of Rome worth one-quarter of a silver denarius, q.v.; later, a bronze coin.
Settlement	an arrangement between brokerage houses for payment or receipt of cash or securities; may be handled through a clearing corporation.
Settlement Date	the date a transaction to be completed.
Share	a unit of stock in a corporation.
Sheffield Plate	a bond of sheet silver to the surface of a copper alloy which is then rolled and manufactured into hollow-ware. Discovered by Thomas Boulsover of Sheffield, England in 1742. (Imitations are made by electroplating silver on copper). Also called "Old Sheffield Plate". To make sure it is Sheffield Plate you can drop a little nitric acid on it. If it is only silver plating, the acid eats through to the base metal.
Shekel	any of certain ancient units of weight. A Hebrew unit equal to about 224 Troy grains weight of silver or just under half a Troy ounce. Gold shekels were about 253 grains Troy or just over half a Troy ounce. The word "shekel" in Semitic languages merely meant "weight". The Hebrew practice was to tariff the gold shekel of 253 grains Troy at 15 silver shekels of 224 grains Troy each. This was a silver/gold ratio of 1:13.3.
Shilling	originally the Anglo-Saxon word "scilling", meaning "a piece cut off". The Saxons had a practice of throwing into the scale pieces of silver objects or of silver coins to make up for loss of weight where payments were being made by weight. In Anglo-Saxon times, the West Saxon shilling contained 5 silver pennies and 240 to 250 silver pennies made up one "pound". The price of a slave was one pound and a horse cost half a pound. Later, an English silver coin first issued in modern British coinage in 1504. King Henry VII who seized the throne following success in battle, is said to have felt that the gap in value between a penny and a pound was too great. Formerly used in Canada, Newfoundland, Australia etc. Name survives as the coinage of countries such as Australia, East Africa, etc. Any of several early American coins. The historian Samuel Eliot Morison, writing in 1965, remembered in his lifetime, Christmas wreaths in Boston, U.S.A. priced at a "shilling" each, six for a dollar.
Short	a trader whose net position shows an excess of sales over purchases; referring to a cash or futures position. A position opposite to a long.
Short Covering	buying back securities or commodities which a trader did not own when he initiated the position.

Short Sales	a sale of securities or commodities, in anticipation of being able to buy them later at a lower price. In securities, the seller or his broker must borrow the securities to make delivery. In commodities, the seller is responsible for delivery at a future date.
Short Ton	2,000 pounds avoirdupois.
Silica	an oxide of silicon; a common example is quartz, in which gold is often found.
Siliceous	containing an abundance of quartz.
Silva	Latin for "forest".
Silver Amalgam	a solid solution of mercury and silver crystallizing in the cubic system. Silver content is usually about 26 per cent, but in the variety arquerite it reaches 86 per cent. It occurs, although rarely, as a natural alloy in both silver and mercury deposits.
Silver Bromide	a compound AgBr that is extremely sensitive to light and is much used in the preparation of sensitive emulsion coatings for photographic materials.
Silver Certificate	paper currency that was issued as legal tender until the 1960's by the U.S. government to represent and be redeemable for deposited silver bullion.
Silver Chloride	a compound AgCl sensitive to light and used especially for photographic materials.
Silver Delivery Bar	a silver bar of 1,000 troy ounces approximately.
Silver Doré	crude silver containing a little gold, say 8 per cent.
Silver Fixing	the London Silver Bullion Market announces this price for silver once a day after the morning gold fix.
Silver Glance	alternative name for the naturally occurring silver sulphide, argentite.
Silver Halides	silver combined with the halogens. A white, curdy precipitate which rapidly darkens on exposure to light — the basis of nearly all processes used in photography. See Halogens.
Silvering	a small silver coin.
Silver Iodide	a compound AgI that darkens on exposure to light and is used in photography, rainmaking and medicine.
Silver Lead Ore	galena containing silver.
Silver Leaf	silver beaten into very thin sheets.
Silver Mirrors	in the 17th century, polished bronze mirrors were replaced by glass mirrors backed by tin amalgam. Five years after Liebig discovered the process, silvered-glass mirrors were first manufactured in 1840, using an ammoniacal solution of silver nitrate.
Silver (native)	silver occurring in nature as the metal, notably in Norway.
Silver Nitrate	an irritant compound AgNO3 that in contact with organic matter turns black. It is the most important therapeutic compound of silver, an antiseptic and astringent. It is used to kill bacteria etc. in and on the human body. It is used on the eyes of new born children in civilized countries. A white crystalline salt. Still called Lunar Caustic when mixed with nitre. Used in photography, dyeing, etc.
Silver Oxide	Medical, Argenti Oxidum, which has been given in cases of epilepsy and chorea.

Silver Pit	trading area on a commodity exchange floor where silver futures contracts are negotiated by public outcry.
Silver Plate	1) domestic holloware and flatware of silver. 2) a plating of silver on an object.
Silver Plating	a technique used to reduce the cost of silvered articles. By using electrolysis, the base metal is coated with a thin layer of fine silver. Discovered by Elkington of England in 1840. The base metal is usually nickel silver, q.v., or Britannia metal, or sometimes brass or copper.
Silver-Platinum	a dental alloy of 50 per cent silver, 50 per cent platinum was once in general use.
Silver Plated Ware	see Silver Plate.
Silver Solder	a group of alloys containing silver, zinc and copper with at least 10 percent silver used for brazing or joining other metals. Also called Brazing Alloys.
Silversmith	one who makes articles of silver.
Silver Standard	a monetary standard based on a stated quantity of silver of a specific weight and fineness to define the basic currency unit.
Silverware	articles made of silver, particularly cutlery or dishes as tableware.
Silvery	1) having the soft clear musical tone of silver; sonorous silver. 2) having the lustre of silver.
Sintering	a technique for consolidating granulated precious metals that have different melting points by melting only one of them.
Skillet	a thick sheet of low carat gold.
Slag	waste matter from smelting or refining a molten metal, consisting of fluxes and refractory materials.
Sleeper	trading term applied to a security believed to be selling far below its value and may easily become of value in the near future.
Slimes	fine fraction of waste material discharged from the mill after valuable minerals have been recovered or are the metallic compounds deposited in the bath during electrolytic refining of metals.
Slough	a place of deep mud or mire.
Sluicing	washing earth or rock containing gold or other heavy minerals through long boxes, provided with riffles and other gold-saving appliances.
Smelt	extraction of crude metal or matte from ore by fluxing and melting, prior to refining.
Smelter Production	the output of smelters from ores and primary materials and occasionally from secondary feed.
Smelting	process of extracting crude metal from its ore or concentrate by fusion, as a preliminary to refining.
Soft Currency	opposite of Strong Currency, q.v.
Solid Gold	one of the most misleading designations which the U.S. Federal Trade Commission permits manufacturers of precious metal products to use. Means simply that the gold

	product is not "hollow". The gold item could have as little as 10 karats and still be stamped solid gold.
Solidus, or Bezant	successful Roman gold coin, of about 70 Troy grains in weight, which developed into the bezant gold coin. The bezant remained important in international trade for over 700 years with an unchanged weight of 65 grains of gold from the 4th to the 12th Centuries A.D.
Sorting	mined ore contains an unavoidable proportion of waste rock. This is partly eliminated in sorting plants on surface or underground.
Sovereign	an English sovereign (face value 1 pound sterling) gold coin in 22 carat (91.67% gold; 8.33% copper). The paper 1-pound note first appeared in 1914 just before World War I, as a substitute for the popular gold sovereign coin. The 1-pound note was withdrawn in 1984 and replaced by a 1-pound face value base metal coin.
Sovereigns (Australian)	sovereigns formerly minted in Australia of 22 carat gold with 8.33 per cent silver instead of copper.
Specie (Espèces, plural; or numeraire; in French)	metal money, (legal), usually meaning "of gold or silver"; metallic currency; money in the form of coins of precious metals. Gold sovereigns (U.K.) are specie, for example, (if genuine). It is estimated that almost 50 per cent of the sovereigns in private possession and trade are not genuine, i.e. not struck in the Royal Mint, although a majority of these non-genuine sovereigns, made in Lebanon etc., contain the correct amount of gold. They might be called "fakes with the correct gold content".
Speculation	putting capital into an enterprise for quick or large returns but with certain risk elements which may endanger the capital. It is a vital ingredient in commodity futures markets because it permits bona fide hedgers to shift their risk.
Split Core	core cut in half — one half used for assaying, q.v. See Core.
Sponge	lumpy form of metal with sponge-like appearance produced by heating to cause the decomposition or reduction of a compound without fusion. Platinum and palladium are sometimes traded in this form.
Spot Price	the going price of silver or gold in the cash market. Used in commodities and foreign exchange to denote something which can be delivered readily. Also refers to the futures contract of the current month; it is still "futures" trading but delivery is possible at any time. See "Cash Price".
Spread	price difference between the bid and asked.
Squeeze	situation where those who are short cannot repurchase their contracts unless at a price substantially higher than the value of these contracts in relation to the rest of the market.
Stamping	mark on a precious metal product which is within the jurisdiction of the U.S. Stamping Act.
Standard Bar	see Good Delivery Bar.
Standard Coin	coin with an intrinsic value whose face value equals its bullion value.
Standard Silver	sterling silver, 92.5% silver.

Stater, or sometimes Argurion when of silver	an ancient weight and coin, of gold or silver, reputedly half an ounce or about 236 to 220 grains Troy, when of silver. Greek word 'stater', to weigh, with the meaning of "a standard".
Statism	the idea of a highly centralized form of government which exerts control over economic planning, as has been attempted in the U.S.S.R. and China.
Sterling Silver	silver of a fixed standard of purity, usually defined legally in the U.K. as an alloy of 925 parts of silver with 75 parts of copper, i.e. 92.5% silver or 925 fine silver. Sterling tableware is a very visible example. The word sterling was used in Anglo-Latin as early as 1180 A.D. and in English in this sense from 1488. See O.E.D. Some scholars believe King John used it regarding silver in about 1300. The word sterling appears in an English law of 1343.
Sterling Vermeil	sterling silver coated with a thin layer of gold of at least 120 micro-inches thickness. See Vermeil.
Stockpile	1) broken ore accumulated in a heap on the surface, pending treatment or shipment. Stockpiles of differing grade may be blended to ensure millfeed has constant characteristics. 2) a stock of metals kept by government for emergencies, e.g. a strategic stockpile.
Stocks	junior security of a corporation, representing an equity interest in the business, but entitled to earnings only after all prior obligations have been met; types: common, preferred, participating preferred, growth.
Stock Split	when a class of stock is divided into a greater number of shares without change in the capital account to reduce the market price of outstanding stock to a more desirable price range and to widen distribution.
Stope	step-like or other excavation in an underground working area for the removal of ore; Old English "staepe", meaning step.
Stoping Width	thickness of ore and waste rock extracted.
Stoploss	a buying or selling order designed to limit potential loss.
Straddle or Spread	simultaneous buying and selling of the same commodity on the same market.
Strike	lateral direction of the reef. Horizontal direction of geological formation or grain or bedding or structure.
Strip Mine	removing earth rock and other material to expose near-surface deposits.
Strong Currencies	currencies that reflect economies of countries which are sometimes in better condition than that of the U.S.A., e.g. Swiss, West German and Japanese, or comparable to the U.S. dollar in strength. See Hard Currency.
Sub-Incline, Sub-Vertical	shafts started from underground workings as second or third stage shaft systems. Same as Winze.
Subsidiary Coin	coins with intrinsic value whose face value is more than the bullion value.
Sutton Hoo Treasure	Anglo-Saxon treasure hoard of gold and silver of the early 600's A.D. discovered in England.

Switch	change made to an existing position by advancing or postponing the original contract into a different month. This is done by liquidating the original contract and re-establishing the same position by a new purchase or sale, i.e. selling one lot of July silver and at the same time buying the lot of September silver.
Switching	exchanging a commodity in one warehouse for a commodity in another.
Syncline	a down-arched fold in bedded rocks.
Tael Bar	used in the Far East in precious metal dealing. Chinese system of weight used for precious metals; 1 tael = 1.2034 troy ounces of pure gold contained. Bars are usually in 1, 5 or 10 tael units.
Tailings	material rejected from a mill after the recoverable valuable minerals have been extracted.
Tale	with regard to silver, an old word meaning "counting". Compare our modern word "tally".
Talent or Kikkar (Talanton in Greek)	an ancient of unit of weight or money, in silver or gold, equivalent to about 1,500 Troy ounces, in Palestine and Syria, equal to 1) 3,000 shekels or 60 minas (manehs) — over 100 lbs. B.H. Warmington states that 40 talents equal 1 ton, or half as much in weight. 2) in Greece, about 6,000 frachmas. In Phoenicia, (now Lebanon) based on Babylonian usage, the weight was about 46.5 kilograms or say 105 pounds avoirdupois. The corresponding word for a talent coin in the Hebrew of the Old Testament was Kikkar, which means disc, circle or globe. see Matthew 25.
Technical Analysis	an approach to market analysis which normally examines patterns of price change, rates of change and volume change by charting.
Tenancy-in-Common	ownership by two or more persons.
10-K Report	a version of an annual report that all U.S. securities are required to file with the SEC and are available to interested stockholders and others which usually contains more detailed information than an annual report. A most valuable document in the study of Canadian mining companies where their shares are registered on U.S. exchanges.
Tenor	grade, particularly of a deposit containing precious metals.
Terminal Market	synonymous with commodity exchange or futures market.
Tetradrachms	Greek silver coins of Antioch etc. Judas received 30 of these for delivering Jesus. Each was then worth 3 Roman denarii, q.v.
Thaler	dollar. Originally heavy silver coins, containing 0.8 troy ounce of silver from the Joachim valley (thal) in Bohemia, called Joachimsthalers, a name which was eventually corrupted to "thalers", "dalers" in Dutch and "dollars" in English.
Thetford Treasure Hoard	One of the largest hoards of Roman silver and gold found in Britain, dating from about 400 A.D., just before the Roman army left Britain forever. Found in 1979. Silver content of the spoons is extremely high, about 97 per cent. The gold objects averaged 94-96 per cent gold, again a very high level.

The Trade	means the bullion dealers.
Thin Market	a market where there are comparatively few offers to sell or bids to buy.
Third Market	over-the-counter market.
Tola (standard)	180 grains, in Pakistan. A Ten-Tola Bar is a popular size used in the East for precious metals.
Tolerance	permissible variation, above and below the desired weight of an object being weighed. Example, plus or minus .05% of an item being weighed.
Toll	the charge for the service provided by a custom smelter, q.v., which is paid by a supplier of mineral concentrates, scrap or blister, usually an independent mine. The service rendeed is the conversion of the concentrates and their return to the supplier as metal in a saleable form.
Toll Refining	in toll-refining, scrap material, concentrates etc. are sent to a refinery, refined for a fee to metals such as silver and gold which are returned to their owner without any change of ownership.
Tombstone	an advertisement that states the name and terms of a security, the underwriters and where a prospectus can be obtained. It does not constitute any offer to buy or sell such securities.
Touchstone	a standard or criterion by which the genuineness of anything is measured. Originally, it was a special stone used to test the purity of gold or silver by the streak left when it was rubbed with the metal.
Trading Limit	1) Maximum price change permitted for a single session. 2) The maximum number of futures contracts which may be traded by a speculator during a single session in any given commodity.
Trading Volume	see below — Volume of Trading.
Transfer Payments	payments to persons for which the recipients render no current services: social security, unemployment compensation and welfare. Also describes payments made to the poorer provinces by the federal government in Canada.
Treasure of Priam	deposit of silver and gold objects found at Troy in Asia Minor (now Turkey), which are not likely to be later than 2,000 B.C.
Tree of Diana	Arbor Dianae: the crystallized dendritic (tree-like or branching form) amalgam precipitated by mercury from a solution of silver nitrate.
Triple Nine Silver	99.9 per cent pure silver.
Troy Ounce	see Troy weight.
Troy Weight	ancient French system of weight taking its name from the mediaval trading town of Troyes in the Champagne-Ardenne area, now primarily used in the United States for precious metals and still in use to some extent in other English speaking countries such as Canada and the U.K. which are still in the process of converting to the metric system. One Troy ounce equals 31.103 g.
Tumbaga	an alloy of gold and copper that looks like solid gold or an alloy of silver and copper that looks like solid silver. See Depletion Gilding.

Tuyère (pronounced "tweer")	a fireproof mozzle, usually of refractory material such as clay, used to direct air blasted by a bellows or fan, into a furnace or bath of molten metal, or through a blowpipe into a fire.
Two Bits	a U.S. 25 cent piece. The dollar was based on the Spanish silver dollar, worth 8 reales or "bits". The 8-reales silver coins were called by the English and Americans, "pieces of eight". See Real.
Umpire Sampling	an assay made by an agreed third party to provide a basis for settlement of value between the buyer and seller of ore.
Uncirculated (UNC) or (BU)	new coins from the regular mint striking which are unused and have never been in circulation and are exactly as they came from the mint, except that if many years old, a slight tarnish or "trone" may have been acquired by silver coins.
Uncut Value	the actual assay value, as opposed to the cut value (of a high assay), which has been reduced by an arbitrary formula.
UNCTAD	U.N. Conference on Trade and Development. Formed in 1964 in Geneva, Switzerland to discuss the trade needs of developing countries and to promote international trade.
Underwriter	a firm that purchases new issues and distributes them.
Unit of Trading	the number of units of the underlying silver designated as the object of a single option, (100 troy ounces of silver on the Toronto Futures Exchange).
Uptick	transaction made at a higher price than the preceding transaction in the same security.
Unwrought	metal in a cast condition, prior to forging, rolling or drawing by mechanical means.
U.S. Gold Coins	contain 90 per cent gold and 10 per cent other metals, mostly copper.
Value-Added Tax (VAT)	an excise tax levied in Western Europe on the value added at each stage of processing a raw material or the production and distribution of a commodity. The impact of a sales tax on the ultimate consumer.
Values	assay results from panning, samples, development or drilling.
Varna Treasure	the world's oldest treasure of gold and silver, found in 1972 in Varna, Bulgaria on the Black Sea. It dates from about 4,000 B.C. Total weight 5.5 kilograms.
Velocity	the number obtained when GNP, (Gross National Product), is divided by the money supply. It represents the number of times per year that each dollar in the money supply is spent on goods and services.
Vermeil (pronounced vair-may)	a layer of gold, usually electroplated, at least 120 millionths of an inch thick, covering an object of solid sterling silver, popular in former times and now becoming fashionable again. It is an ambiguous word still incorrectly thought to apply only to sterling silver covered with a thin layer of gold, but in fact vermeil can be applied to many metals, including non-precious ones — compare silver gilt, gilt bronze.
Very Fine (VF)	coins which have circulated slightly but are almost in mint condition, with some lustre. Some light wear on high spots is permissible.
Very Good	well worn coin with considerable wear, but with main features clear and bold although rather flat, with high points of detail worn smooth.

Virgin Silver	newly refined silver of commercial quality, usually of primary origin, i.e. from a mine.
Visible Supply	the amount of a commodity in store at leading points.
Volume of Trading	number of contracts traded during a daily session. A purchase and sale equals one trade.
Vulchitrun Treasure	superb examples of Thracian art in precious metals total weight 12.5 kg. found in Northern Bulgaria dated to between the 15th and 12th centuries B.C.
Wafer	designation for bullion produced in a small, thin form, e.g. a one ounce silver wafer.
Warehouse Receipt	see Warrant.
Warrant (or Warrant of Settlement)	the document of title issued by a bank or a warehouse registered on a metal commodity exchange such as the New York Mercantile Exchange which shows title to the precious metal stored physically in the bank or approved warehouse. It is usually endorsed in favour of the person named on the document or is made out as a bearer instrument. It describes the brand of metal, the refiner, the weight, the number of bars etc. It is in effect a "demand note" to the warehouse or bank.
Waste	barren rock in a mine or at least mineral material that is too low in grade to be of economic value.
Wheal	Cornish (Celtic) name for a mine, e.g. Wheal Jane, Wheal Rose, Wheal Newton etc. in Cornwall.
When Issued	a new securities issue that has been duly authorized but is not actually outstanding and in the hand of the purchaser. Labelled by "wi".
White Gold	a class of jewellery alloys used as substitutes for platinum — normally contains either 12% Palladium or 15% Nickel but can be combinations of silver, zinc, copper, nickel and palladium.
Width	1) ore reserves: estimated stoping width of the working area from which the ore will be mined; 2) channel width: overall thickness of reefs and internal waste; 3) reef width: actual thickness of the gold-bearing rock layer, exclusive of waste.
Winze	a vertical or inclined opening sunk from inside a mine, i.e. internal shaft.
Witwatersrand	"ridge of white waters" in the Dutch-origin language of the Boers, (Afrikaners). Gold bearing region near Johannesburg from which silver is also derived.
Working Profit	gross profit from the mining operation before providing for interest and taxation or for expenditure on capital account.
Wrong Planchet	a coin struck on a blank intended for another denomination.
Year Mark	a letter symbol stamped onto silver or gold by British silver and gold makers or hallmarkers.
Yield	1) actual mineral grade realized at the reduction plant; 2) rate of return available on a security, expressed as a percentage of the current market price.

Zone of Oxidation	upper part of a mineral deposit that has become oxidized.

T.P. Mohide
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